CONCENTRATION IN THE STEEL INDUSTRY

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Criticism and comment do not, of course, imply assumption of responsibility; that remains with the writer alone.

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INTRODUCTION

The basic purpose of this investigation is to discover whether the steel industry in the United States has become more or less monopolistic over approximately the last fifty years. This type of study should be regarded as one of the steps in answering the much broader question of whether the monopoly problem in the whole economy is becoming more serious.

I take the position that we lack the knowledge necessary to answer the broad question. In fact, our ignorance is profound. This is certainly not attributable to any lack of attention to the monopoly problem, for there is literature in great quantities. Much of this literature, however, is not directed to the problem of monopoly's long term development. Some of the work has sought to discover present areas of monopoly rather than its development. This was undoubtedly the orientation of the TNEC investigation in both hearings and monographs. Other studies have been histories or analyses of the various devices of monopoly and as such do not have direct bearing on the extent of monopoly or its development.[1] Still other studies have attempted to generalize for the whole economy by a procedure that neglected industry lines, and hence monopoly power. A case in point is the frequent reference to the "control" exercised by the two hundred largest non-financial corporations.[2]

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[1]This group is exemplified by A. R. Burns' The Decline of Competition (New York: McGraw-Hill, 1936) and Frank Fetter's The Masquerade of Monopoly (New York: Harcourt, Brace, 1931).

[2]The origin of these references is presumably The Modern Corporation and Private Property by A. A. Berle, Jr. and G. C. Means (New York: Macmillan, 1933). These two writers are not to be held responsible for the extensive misuse to which their data have been subjected, although it is clear that their data were presented as evidence for an increase in oligopoly as well as to show the importance of the corporation as a business organization device. For example, the following statement is made on page 45: "Competition has changed in character and the principles applicable to present conditions are radically different from those which apply when the dominant competing units are smaller and more numerous. The principles of duopoly have become more important than those of free competition."

The present investigation makes a contribution to the study of the development of monopoly by studying one important industry. A study of one industry, even though an important one, is but a small part of the work that is necessary for a well based generalization on the economy as a whole. It is not maintained that an industry by industry study is the only way to deal with this problem. But studies of separate industries can illuminate the operation of forces making for monopoly in a way that is at best difficult if large groups of industries are dealt with at the same time.

It should be remembered that this study is mainly concerned with the long run increase or decrease of monopoly in the steel industry, and not with determination of the absolute degree of monopoly in some sense. The former question is probably easier to deal with, because if the bulk of the relevant forces are operating in the same direction, a summary judgment is possible even though a quantitative value cannot be assigned to the change.

A few comments on terminology may be helpful. One usage of the terms "concentration" or "monopoly" is illustrated by the assertion that they are increasing in importance. In this sense these terms are used loosely to cover many sorts of departures from competitive conditions. This usage will often be followed here. There should be no confusion, because context always makes the meaning clear. It is only rarely that the term "monopoly" will be used in the narrow, technical sense.

It is interesting to observe that attempts summarily to indicate the degree of monopoly power by the use of a measure based on the size structure of firms in an industry have usually used the term "concentration" rather than "monopoly." A measure of concentration may be characterized as an easily ascertainable index, based on one, or at most a few, of the many variables that determine the degree of monopoly in an industry. These measures

deserve the attention that has been devoted to them. If a more definite interpretation can be made of some of these, and their limitations more precisely ascertained by studying the relationships between the summary measures and more complete analyses of market situations, a more economical and continuous check could be made on the development of monopoly in the economy and their many other uses can be more intelligently interpreted.

In addition, anti-trust law is assigning the size structure of firms a greater importance than formerly. Something less than one hundred per cent control of an industry is sufficient to make a showing of monopoly under the Sherman Act even in the absence of traditional acts in restraint of trade.[1] The law will undoubtedly continue to use summary ideas resting on the size structure of firms. The economist will perform an important service if he can develop a more adequate account of the relationships between measures of concentration and market behavior.

The body of this study will begin with a general discussion of measures of concentration and their limitations. Then a summary measure of concentration will be applied to the steel industry to show changes in the size structure of firms that have taken place during the last half century. Other indicators of monopoly power will be examined to see if the results of the

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[1]See, for example, the opinion of Judge Learned Hand in U. S. v. Aluminum Company of America (148 F. 2d 424 /1945/) where he writes, "That percentage /over ninety/ is enough to constitute monopoly; it is doubtful whether sixty or sixty-four per cent would be enough; and certainly thirty-three per cent is not." The dissent of Justice Douglas in U. S. v. Columbia Steel (334 U. S. 540 /1948/) is still stronger: "Its /the acquisition of Consolidated Steel by U. S. Steel/ serious impact on competition and on the economy is emphasized when it is recalled that U. S. Steel has one-third of the rolled steel production of the entire country. The least I can say is that a company that has that tremendous leverage on our economy is big enough."

concentration measure are corroborated. Finally, there will be a few brief remarks on the implications of this kind of investigation for government policy toward industry.

CHAPTER I

THE CONCEPT OF CONCENTRATION

Plan of the Chapter

In the attempt to delimit the concept of concentration, the first task will be an examination of previous uses of the concept. It will be found that one meaning of the term is as all-inclusive as the term monopoly in the loose sense. A second group of writers makes domination by the larger firms the core of the concept. The idea of domination has much in common with the concept of inequality as used with reference to the distribution of personal incomes. The idea of domination has been applied both with and without reference to industry lines.

The equating of concentration to domination is so widespread that there are only faint suggestions in the literature that the number of firms should be incorporated in the concept of concentration. It will be suggested that the concept can usefully be broadened so as to distinguish concentration from inequality. A descriptive measure incorporating this amended meaning will be proposed.

Previous Uses of the Concept

The term concentration by now has become a part of the vocabulary of non-economists as well as of economists. When the term is used in a broader sense than is implied by the statistical measures that have been used, it becomes a synonym for monopoly as used in non-theoretical discussion.

An example of this vague use of the term which seems to equate it to any non-competitive situation is to be found on the cover of every TNEC monograph: ". . . a select committee to make a full and complete study and

investigation with respect to the concentration of economic power in, and financial control over, production and distribution of goods and services."[1]

There are many writers that might be cited to show the important part that domination plays in their versions of the concentration concept. Certain portions of The Modern Corporation and Private Property are a case in point.[2] This is one of the most widely quoted of the studies on concentration. The part of the volume with which we are concerned presumably is the work of Gardiner Means.

This study did much to establish the precedent that the meaning of the central concept of concentration is so self-evident as to require no analysis. At the opening of a chapter entitled "The Concentration of

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[1]A similar use of the term is made by Purdy, Lindahl, and Carter, who use the term "concentration" in the title of their book as presumably the best general description of its contents, although at one time the subject matter would have been suitably described by some variation on the terms "monopoly" or "trust." See H. L. Purdy, M. L. Lindahl, and W. A. Carter, Corporate Concentration and Public Policy (New York: Prentice-Hall, 1942). A recent textbook example of the general use of the term is provided by Burns, Neal, and Watson. The chapter entitled "Concentration and Regulation of Industry," opens with this statement: "In recent times, and especially since the 1870's, considerable attention has been centered on economic concentration--the aggregation of economic resources by the largest firms." See A. E. Burns, A. C. Neal, and D. S. Watson, Modern Economics (New York: Harcourt, Brace, 1948), p. 585. The explanatory statement at the end of the sentence indicates that the term may be used without reference to industry or product lines. It may be applied to the whole economy or to a large sector of it as well as to separate industries.

The same explanatory statement also indicates a facet of all uses of the concentration concept, domination by the larger firms. This feature is present whether the concept is applied to a group of industries or only to single industries. The close relation between domination and inequality has already been pointed out.

[2]It will be recalled that this volume was much more than a study of concentration. It provided an informative analysis of the methods by which the device of the corporation has been put to "effective" use.

Economic Power," Means writes:

> The corporate system has done more than evolve a norm by which business is carried on. Within it there exists a centripetal attraction which draws wealth together into aggregations of constantly increasing size, at the same time throwing control into the hands of fewer and fewer men.[1]

He goes on to say, "So far as can be seen, every element which favored concentration still exists, and the only apparent factor which may end the tendency is the limit of a few human beings effectively to handle the aggregates of property brought under their control." From these quotations it is evident that domination is the core of Means' concept of concentration.

Later Means comes to closer grips with the problem of measurement:

> While these companies [the two hundred largest non-financial corporations] play an integral part in the business life of the country, their dominant position becomes apparent only when we seek to examine their importance in relation to the whole of the American economy. Here we must turn to the tool of statistics for only thus can we grasp the picture of economic life as a whole. To make a statistical comparison of the relative importance of the large corporations, it is first necessary to decide upon a measure of importance. Since this study is primarily concerned with property, we have taken wealth, the economic equivalent of property, as the criterion of "importance" and have further assumed that the gross assets [ex depreciation] controlled by a corporation are roughly proportional to its wealth. Wherever possible, however, the results obtained have been checked by the use of a second measure of importance--net earnings.
>
> In seeking to present a picture of the relative positions of these large corporations, four economic areas will be examined: (1) the New York stock market; (2) all corporate wealth; (3) all business wealth; and (4) the national wealth.

That is, the relative position of "the two hundred" is to be described by the percentages their total assets are of the total "assets" of each of the four groups listed at the end of the quotation. If this measure of concentration were to be made more general, the object of measurement would be

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[1]Berle and Means, op. cit., pp. 18ff.

the inequality in the distribution of non-financial corporate assets. Concentration for Means is domination or control by larger corporations.

Another writer for whom concentration means domination is W. F. Crowder. From the point of view of statistical description, his is probably the most complete study of concentration to date.[1] From this study, the close relationship between domination and inequality can easily be seen.

Crowder analyzed 1,807 products, as defined in the Census of Manufacturers for 1937, on a firm basis rather than the usual establishment basis.[2] He used as his measure of concentration the percentage of the product's total output produced by the four largest firms. At no point does there seem to be a detailed discussion of the concept of concentration. That is, there is no attempt to justify choice of this particular concept, although there is much statistical analysis based on it.

There are two major defects in Crowder's statistical measure. First, it does not have integrated into it the important datum of the number of firms in the industry. It will be argued at a later point that the number of firms cannot be neglected. Crowder does give the number of firms in a separate column, but the number of firms affects his measure of concentration only in so far as it affects the portion of industry output accounted for by the four leading producers. Secondly, Crowder's measure does not convey at all clearly the extent of domination by the leading firms. What is

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[1] W. L. Thorp, W. F. Crowder, and associates, The Structure of Industry, TNEC monograph No. 27. Crowder is responsible for part five, "The Concentration of Production in Manufacturing," which is the immediate concern here.

[2] One firm may have several establishments. Because of the great difference between the distributions of firm outputs and establishment outputs, data on an establishment basis, which is the only form in which data for the Census of Manufactures have ever been tabulated aside from special studies such as Crowder's, are practically useless for analysis of changes in concentration.

conveyed and what is not conveyed by the measure can be seen by putting it into the form of a modified Lorenz curve with output on the vertical axis, ranging from zero to one hundred per cent of the industry output, and with the number of firms plotted in absolute values on the horizontal axis, as in Figure 1.

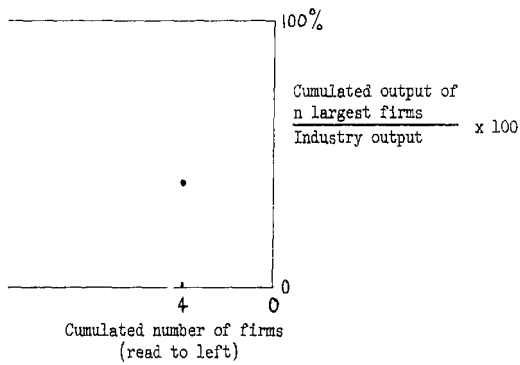

Figure 1

If the datum of the number of firms in the industry is introduced, it becomes possible to take a crude measure of the degree of inequality among firm outputs since there is one point on a Lorenz curve and the "line of equality" is determined. This is shown in Figure 2. There can be many Lorenz curves that pass through this given point, however. Some of these curves will indicate widely differing degrees of inequality in outputs. There will be the same difficulty with any measure of inequality that does not utilize data for the whole distribution of outputs. To summarize, inequality seems to be the fundamental idea in Crowder's concept of concentration, although his measure is unsatisfactory.

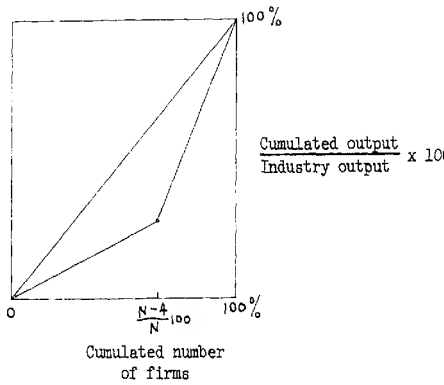

Figure 2

In connection with Crowder's measure of concentration and other measures that are fundamentally measures of inequality, it is often asserted that concentration in this sense will be greater for the separate products made by firms in an industry than for total firm outputs including all the products they make.[1] If the reader, on encountering this common assertion, interprets it to mean that monopoly power increases as product is more narrowly defined, it should be remembered that on the buying side of the market, the more detailed is the product classification, the better will be the substitutes for any given product; on the production side of the market, the

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[1] See, for example, p. 301 of TNEC Monograph No. 21, Competition and Monopoly in American Industry, where Wilcox states, "Since an industry, as defined by the Census, may manufacture many different products and since any one of these products may be made by but a few of the concerns that are classified as belonging to the industry, it is obvious that concentration of control over individual products must be even greater than the foregoing figures [dealing with total firm outputs] reveal."

more detailed the product classification, the easier it will be for other firms to switch their production in the direction of the product in question.[1] Sometimes, of course, the assertion of an increase in concentration with the fineness of product classification is accompanied by an express warning that this carries no necessary implication for monopoly power.[2]

Actually, if inequality is measured from a Lorenz plot, the inequality of the distribution of the firms' total outputs is a weighted average of the inequalities of each of the separate product distributions. Except in one circumstance, the inequalities of some of the distributions for separate products will be less, and for others will be more than the inequality for the distribution of total firm outputs. This can be illustrated by a simple hypothetical example. Assume an industry with three firms, with each firm making three products, A, B, and C. Their outputs and the measures of inequality are shown in the tabulation below:

	Product (value terms)			
	A	B	C	Total firm outputs
Firm No. 1	9	7	6	22
2	3	6	5	14
3	2	1	3	6
Product total	14	14	14	42
Inequality[3]	.33	.29	.14	.25

[1]The point here is essentially the same as that involved in a similar assertion that is frequently encountered to the effect that if the expenditure on a certain productive service is but a small part of the total cost of the product, the demand for the productive service will be inelastic. As it stands, this assertion is not necessarily true either.

[2]Ibid. Wilcox says, "While such concentration does not invariably involve monopolistic control over prices and production, the one is frequently conducive to the other."

[3]Inequality, as measured from a Lorenz plot, is equal to

There is specialization in this industry: firm one specializes in product A; firm two in B; and firm three in C. Still, inequality for one of the products is less than inequality for total firm outputs.. Notice, however, that the ranks of the firms' outputs are the same for each product. If this were not true, then it would be possible, but not necessary, for the inequalities of all the product distributions to be greater than the inequality in the distribution of total firm outputs. That is, this result is possible if there are enough cases in which a small firm produces more of a particular product than a larger firm. A distribution giving this result is shown below:

	Product (value terms)			
	A	B	C	Total firm outputs
Firm No. 1	6	4	3	13
2	3	1	5	9
3	1	5	2	8
Product Total	10	10	10	30
Inequality	.33	.27	.20	.11

There is specialization by product in this distribution as there was in the previous distribution. But here the specialization is so great that the firms' ranks for products B and C are different from total output ranks. This is a necessary condition for the inequalities of separate product distributions to be greater than the inequality in the distribution of total firm outputs.[1]

$\frac{(n-1)\sum_{i=1}^{n} x_i - 2\sum_{j=1}^{n-1}\sum_{i=1}^{j} x_i}{n\sum_{i=1}^{n} x_i}$, where there are n members of the distribution. In graphic terms, this is equal to the area between the "line of equality" and the Lorenz curve divided by the area (equal to one-half) below the "line of equality."

[1] This analysis, which is not relevant to the main argument of the chapter, is pursued further in Appendix II at the end of the chapter.

Before the preceding digression, it was shown that the idea of domination holds a central position in the concept of concentration, and that domination is very similar to inequality. The question of the aggregate to which the concentration concept is ordinarily applied has not yet been considered.

Gardiner Means, in The Modern Corporation and Private Property, did not explicitly consider whether concentration should be measured for industries taken separately or for a group of industries. The solution he did adopt, namely, the lumping together of all corporations with the exception of financial corporations, completely begs the question of the structure of competitive relationships among corporations. The important thing to note is that industry lines, governmental restriction (as on public utilities and transportation), product substitution (as between firms in an industry and also between industries), and foreign competition are conceived to have no effect on the outcome of an increase in concentration in Means' sense.

Furthermore, Means' procedure strongly implies that there is group action on the part of the two hundred largest corporations. There is evidence for this interpretation at a later point in the chapter. Means writes:

> Therefore, if roughly half of corporate wealth is controlled by two hundred large corporations and half by smaller companies it is fair to assume that very much more than half of industry is dominated by these great units. This concentration is made even more significant when it is recalled that as a result of it, approximately 2,000 individuals out of a population of one hundred and twenty-five million are in a position to control and direct half of industry.[1]

But control and direct in what sense? The passage cries for amplification and explanation. Do the 2,000 act as a group? Is there an alliance

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[1] Means, op. cit., p. 33. "Much more than half of industry is dominated" because, he asserts on p. 32, ". . . the influence of one of these huge companies extends far beyond the assets under its direct control."

between movie and railroad magnates? Perhaps the separate stores and catalogues of Montgomery Ward and Sears, Roebuck are mere facades of independence after all.

The combining of different industries is not the usual practice, however. More often, industries are treated separately. This was W. F. Crowder's procedure. Another example is provided by Harry Laidler.[1] Unlike Means, he gives his principal attention to particular industries, with industry defined conventionally. The general plan of his study is examination of a number of industries, one at a time, rather than any attempt to deal with the whole economy at once or with industry in general.

It should be pointed out that some of his pronouncements at the beginning and the end of the book indicate that he is also willing to apply the concept of concentration on a broader scale. As evidence pointing to the development of concentration in this broader sense he cites establishment data from the Census of Manufactures, studies of the merger movement, Means' data, and the general history of the trust movement referring to the various devices that have been used through the years to mitigate the rigors of competition such as the pool, trust, holding company, merger, interlocking interests, non-voting stock, and the like. More specifically, Laidler states, "But our study is not a study merely of trusts and monopolies. It is a study of industrial and financial concentration in general."[2] In spite of this, his root conception of concentration, as evidenced by the plan of the major portion of the volume, is at the industry level, subject to an attempt

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[1] H. W. Laidler, Concentration of Control in American Industry (New York: Crowell, 1931).

[2] Ibid., p. 435.

at summary judgment of "industry in general" and subject also to modifications that might be introduced by devices that produce inter-industry cooperation.

On the question of whether the number of firms should be given an explicit place in the concept of concentration, the verdict of usage is clear. The number of firms is never incorporated in a statistical measure of concentration. At only one point have I been able to find a suggestion that the number of firms in an industry is relevant for concentration. This suggestion comes from Purdy, Lindahl, and Carter, but the point is not pressed: "When as a result of concentration the number of firms producing a physically similar product is reduced to a small figure, one important condition for complete competition will almost certainly be missing."[1]

A sufficient number of writers has been examined to give an impression of the fundamental ideas that would be useful in a concept of concentration to be used in a historical study for descriptive purposes. Such a concept will be formulated in the following section.

A Suggested Concept of Concentration

The purpose of a concentration ratio presumably is to show the likelihood of monopolistic policies in an industry. But since our knowledge of the determinants of monopolistic policy and their interrelationships is incomplete, a concentration ratio cannot be deduced which is firmly grounded in theory.

Although the theoretical foundation of the concentration ratio may be somewhat obscure, it may still possess heuristic value and, in turn, may

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[1] Purdy, Lindahl, and Carter, op. cit., p. 468.

provide the theorist with valuable clues. One purpose of this study is to find the extent to which the proposed measure of concentration and others vary from independent measures of the trend of competition in the steel industry.

The proposed concept of concentration will be applied to the industry rather than to some broader sector of the economy. This seems to be a common sense procedure, for if there is danger that monopoly power is growing, it must lie in considerable part in the possibility of concerted action by firms that are related to each other. The pertinent relation among the firms is to be found in their products, whether related in demand or in production, and this means an industry.

Aside from dynamic and extra-industry factors, at least two aspects of industry organization are important for a concentration ratio that is to predict the probability of monopolistic policy: first, the number of firms in the industry, and second, the size-location configuration of the large firms.

In spite of the fact that it is widely appreciated that the number of firms in an industry has an important bearing on the outcome of a market situation, a good deal of the discussion of concentration neglects the numbers aspect. It is possible that words may be tricking these writers. In discussions of the distribution of incomes, "concentration of income" is often used interchangeably with "inequality of income."[1] Perhaps it is

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[1]Allyn Young once proposed, however, that concentration be distinguished from inequality. He would have reserved the term concentration for extreme inequality. He also remarked, "But we have no definite standard of what constitutes justifiable, permissible, or normal concentration." See his article, "Do the Statistics of the Concentration of Wealth in the United States Mean What They are Commonly Assumed to Mean?" in Journal of the American Statistical Association, XV (March, 1917) 476.

understandable that concentration would be implicitly defined in the same way when the term is used for a quite different matter. In connection with incomes, it is only their distribution among a certain defined type of income recipient that is of interest. That is evidenced by the fact that every proponent of a measure of income inequality insists that the measure be independent of the number of income recipients (and also of the unit of income measurement).

Extension of this condition to the study of concentration of control in an industry is unfruitful because neglect of the number of firms means the omission of an important piece of information, granted that it is far from the only determinant of a market result. The difficulties encountered by focusing attention only on inequality of firm outputs may be illustrated by a simple example. Suppose that one firm controls sixty per cent of a market. If there is but one other firm in this market, the Lorenz plot is that in Figure 3A.

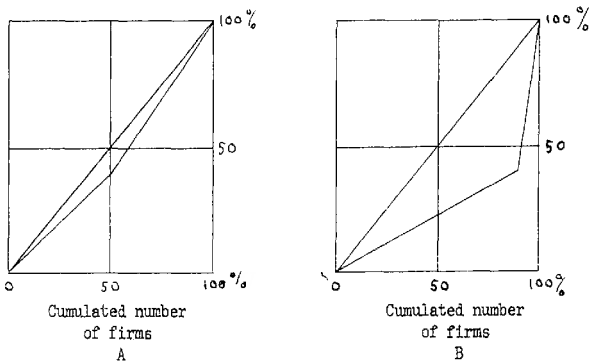

Figure 3

If the larger firm continues to control sixty per cent of the market but the remaining forty per cent is divided equally among nine firms, the Lorenz curve is that of Figure 3B, and inequality by almost any measure has increased. In the sense often used, concentration has increased, but it is not evident that action inimical to the interests of the buyers is more likely in the second situation, and in fact the opposite is more likely. If attention is focused only on the share held by the top firm, there is no indicated difference between the two situations. The same general objection can be made to the focusing of attention on the share held by the top three or four firms, or whatever number may be seized upon.

The number of firms has an obvious bearing on the difficulty of securing agreement among the firms in an industry. In addition, even though many of the firms are small in comparison with the larger firms, the larger the number of firms, probably the easier will be conditions of entry. The co-existence of small and large firms may indicate that entry is possible without meeting very large capital requirements and also that economies of scale do not present an insuperable obstacle.

All the users of the concentration concept take account of the size configuration of the firms in the industry. That is, they all attempt to indicate the degree of domination by the large firms. At bottom, this idea has much in common with the concept of inequality as used in the study of incomes. Many measurements of concentration are nothing but limping measures of inequality. Such statements as that the top two hundred control forty-nine per cent of the assets or that the top four control sixty per cent of the output are nothing but statements of points on, say, a Lorenz curve. In much of the incidental reference to concentration, where measurement is not

attempted, this also appears to be the conception that is used. While the proposed measure of concentration takes account of the size distribution of the firms, it does not directly take account of their locational configuration.

A simple measure which goes some distance toward incorporating both the number of firms and the degree of domination by the large firms would be:

$$C = \frac{\sum_{i=1}^{n} x_i^2}{\left(\sum_{i=1}^{n} x_i\right)^2}$$

where C stands for concentration, there are n firms, and x_i is the output of the i'th firm. The meaning of this measure may be elucidated in two different ways. First, it may be regarded as a weighted average of the ¢/100 market shares possessed by each firm in the market. If these shares are averaged with each share receiving equal weight, the result is, of course, 1/n:

$$\frac{\sum_{i=1}^{n} \frac{x_i}{\sum_{i=1}^{n} x_i}}{n} = \frac{\frac{\sum_{i=1}^{n} x_i}{\sum_{i=1}^{n} x_i}}{n} = \frac{1}{n}$$

But it is reasonable that the market share of a larger firm should receive a greater weight than the market share of a smaller firm. If each market share is weighted, not by one, but by itself (the sum of the weights is one), then

$$C = \frac{\sum_{i=1}^{n} \left(\frac{x_i}{\sum_{i=1}^{n} x_i}\right)^2}{i} = \frac{\sum_{i=1}^{n} x_i^2}{\left(\sum_{i=1}^{n} x_i\right)^2}$$

Perhaps a more illuminating interpretation is to regard the measure as made up of the product of two measures, one taking account of the number of firms and the other taking account of inequality by measuring relative dispersion, granting that a measure of dispersion is not wholly satisfactory as a measure of inequality. C is the product of 1/n and the square of the coefficient of variation plus one:[1]

$$C = \frac{1}{n}\left(1 + V^2\right).$$

If the x_i's are positive, the limits of C are zero and one. The upper limit is attained when the number of firms is reduced to one. A distribution of equal outputs is represented by C = 1/n.

This measure can be given a convenient graphic representation. In Figure 4, each side of the large square is equal to (Σx). Its area is $(\Sigma x)^2$. On the bottom side of the large square, (x_1), ..., and (x_n) are plotted adjacent to each other and in order of size. The ratio of the area enclosed by the small squares to the area of the large square is C. The dotted line, of height $\frac{\sum_{i=1}^{n} x_i}{n}$, represents an equal distribution of total outputs among the firms. The output of the firm relative to industry output may be used as the unit instead of absolute output, thus leaving for consideration only the number of firms and the distribution of their outputs.

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[1] $$\frac{1}{n}\left(1+V^2\right) = \frac{1}{n}\left(1 + \frac{\frac{\Sigma x^2}{n} - \frac{(\Sigma x)^2}{n^2}}{\frac{(\Sigma x)^2}{n^2}}\right)$$

$$= \frac{1}{n}\left(\frac{\Sigma x^2}{n} \cdot \frac{n^2}{(\Sigma x)^2}\right) = \frac{\Sigma x^2}{(\Sigma x)^2} = C$$

In this case each side of the large square is equal to one. At the end of this chapter is appended a discussion of some additional properties of this measure of concentration.[1]

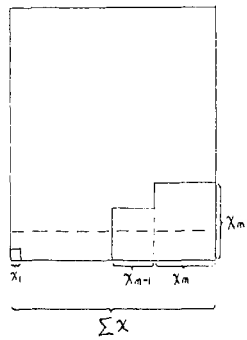

Figure 4

This measure is descriptive and its relation to monopoly power is not at all clear a priori. It seems reasonable to suppose that changes in concentration, as defined herein, will not correspond to any changes in monopoly power until concentration has reached a certain "threshold" level. After that point is reached, there is no certainty that the relative weights of number of firms and inequality of outputs are such as to make the measure vary in a simple fashion with monopoly power, assuming other relevent factors to be constant. The usefulness of the measure lies in providing a definite

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[1]Professor Malcolm Hogg has brought to the writer's attention the fact that Albert O. Hirschman proposed the same expression as a measure of concentration, except for a square root sign, in National Power and the Structure of Foreign Trade (Berkeley: University of California Press, 1945), pp. 158-62. He did not view the index as a weighted average nor give a graphic representation.

description of gross changes and in furnishing a focus for further judgments about the data.

The limitations of a concentration concept and its place relative to the general problem of measuring and describing monopoly have not yet been examined. It is immediately apparent that the proposed concept leaves much to be desired as a measure of monopoly power. There is available a neat measure of the degree of monopoly power in Lerner's $(P - MC)/P$.[1] This measure sums up a host of factors which play a part in determining price and output and, hence, monopoly power. The effectiveness of substitutes is taken account of, for the better the substitutes, the smaller will be the discrepancy between price and marginal cost. Potential competition is taken account of if long run demand and cost are used. The threat of governmental regulation is recognized in the measure, and the vexatious problem of defining a commodity or an industry is disposed of by treating every firm separately.

The difficulty comes, however, in attempting to apply the measure. In spite of the fact that it is not necessary to estimate marginal revenue, there still remain some difficulties over and beyond the mundane ones of gathering and rectifying data for estimates of marginal cost. Leaving aside the problems arising from advertising and similar marketing costs, it is to be doubted that a statistical estimate of marginal cost will measure the marginal cost that is relevant for this problem. In applying this measure, it must be applied to situations in which the firm is operating under changing conditions. Its plant does have a future value and does wear out because of use. This implies that the marginal cost relevant for output decisions must contain an

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[1] A. P. Lerner, "The Concept of Monopoly and the Measurement of Monopoly Power," Review of Economic Studies, I (1933-34), 157.

expectational element, which element may produce a divergence from an estimate of marginal cost based on recorded variable or total costs. Use of a plant now involves some sacrifice of the opportunity to use it at a later and perhaps more advantageous time. If the relevant marginal cost differs from an estimate of marginal cost based on recorded costs, Lerner's measure of monopoly power will show something different from what is actually the case.[1]

A further, and perhaps more important objection, is that this measure gives only the degree of monopoly but does not show its importance. By the measure alone, a purely local monopoly of an unimportant commodity cannot be distinguished from a countrywide monopoly of an important commodity. One solution would be to multiply Lerner's measure by the difference between monopoly and competitive outputs.[2]

In any event, the difficulty of collecting the data for estimates of marginal cost is controlling. If Lerner's comprehensive measure cannot be applied at this time, the alternative is to get some indication of the degree of monopoly and of changes in the degree of monopoly by studying observable characteristics that do play a part in determining the outcome of a market situation. The factors that can be observed will not be sufficient to determine completely the market result nor is it possible to observe and tag the market result directly. In this study, attention is given concentration with the realization that changes in it through time or differences at the same moment of time are not rigidly connected with monopoly power. But there are still good reasons for devoting attention to concentration. In spite of the loose

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[1] For analysis of marginal cost under conditions involving uncertainty, see A. C. Neal, "Marginal Cost and the Dynamic Equilibrium of the Firm," Journal of Political Economy, L (1942), 45.

[2] This point was suggested by Professor George J. Stigler.

connection between it and the degree of monopoly power, the number of firms and the distribution of output among firms are beyond doubt among the most important determinants of the market outcome. In recognition of this relevance, concentration has received a great deal of attention, but the implication of much that is written, namely, that it is increasing in degree and that the extent of monopoly is accordingly increasing, is based largely on conjecture. In view of the fact that it appears difficult for economists to approach this problem in a disinterested fashion, without often seeming to be either apologists for the status quo or despairing admirers of a properly functioning competitive system, the need is pressing for evidence more weighty than general impressions.

APPENDIX I TO CHAPTER I

SOME PROPERTIES OF THE PROPOSED MEASURE OF CONCENTRATION, C

The two elements of C, the concentration coefficient, are the number of firms in the industry and the inequality of the distribution of outputs as measured by the coefficient of variation. The relation between these two elements is shown graphically in Figure 5 with the number of firms shown as a function of the coefficient of variation with C held constant.

It is evident from the chart that the coefficient of variation must increase in order to offset an increase in N if C is constant. If industry output is considered to be constant, this increase must come about by a combination of increasing the frequency of smaller firms and increasing the size of the larger firms. The maximum V^2 that could be obtained is (N-1).[1] "Large" coefficients of variation are found in the distributions dealt with in Chapter II. For example, the 1948 distribution of steel ingot capacity has a coefficient of variation of 3.44.

The next graph (Figure 6) shows the effect on C of adding a new firm to the industry. The output of the added firm is expressed as a fraction (k) of the original industry output. C_1 (concentration after the addition of the new firm) is shown in the graph as a function of k for constant

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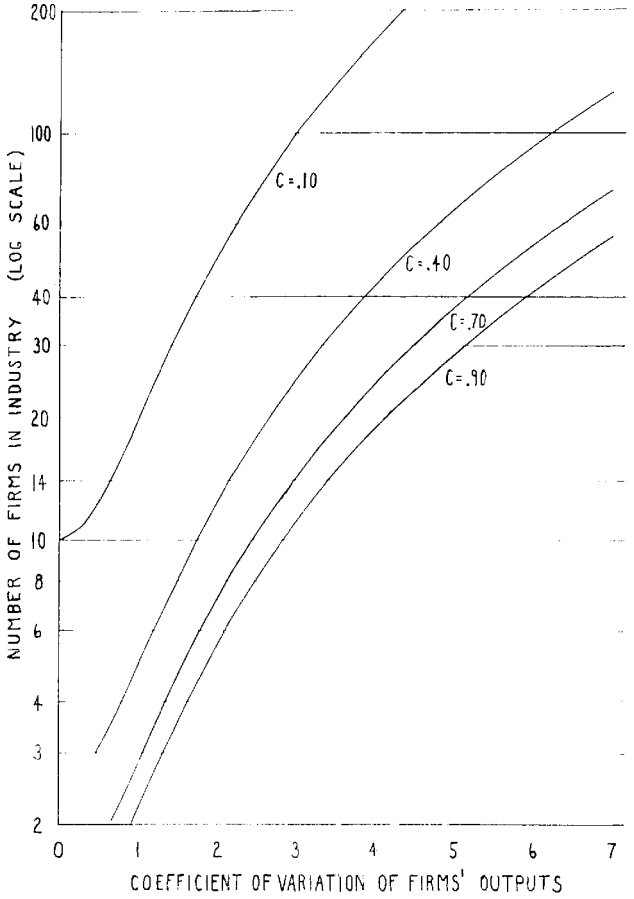
[1] This may be seen from $C = \frac{\sum x^2}{(\sum x)^2} = \frac{1}{N}(1 + V^2)$.

If N and industry output are constant, C and V^2 are maximized by making $\sum x^2$ as large as possible; that is, by having the output of one firm approach the industry's output.

FIG. 5

COMBINATIONS OF NUMBER OF FIRMS AND COEFFICIENT OF VARIATION FOR CONSTANT COEFFICIENT OF CONCENTRATION (C)



levels of C_o (concentration before addition of the new firm).

With $C_1 = \frac{C_o + k^2}{(1 + k)^2}$, it is evident that[1]

(1) $C_1 = C_o$ when $k = 0$.

(2) C_1 is at a minimum when $k = C_o$. There is only one minimum.

(3) $C_1 = C_o$ when $k = \frac{2C_o}{1 - C_o}$.

There is a point of inflection at $\frac{3C_o + 1}{2}$ with the second derivative positive up to this point. As k increases, the curves for different levels of C_o converge. This is a consequence of the fact that C_1 has one as its limit. It is obvious that the curves cannot intersect.

It is apparent from the graph that when C_o is small, the output of the added firm must be small if C_1 is to be less than C_o. The larger C_o, the greater the range of outputs for a new firm which will make C_1 less than C_o.

Concentration is always increased by a consolidation. (And a breakup of a firm into two or more firms will always decrease concentration, whatever the size of the firm broken up.) Consider a consolidation of firms a, b, etc. Summated quantities are taken before consolidation.

$$(C_1 - C_o) = \frac{\sum_{i=1}^{n} x_i^2 - x_a^2 - x_b^2 \ldots + (x_a + x_b + \ldots)^2}{(\sum_{i=1}^{n} x_i)^2} - \frac{\sum x^2}{(\sum x)^2}$$

$$= \frac{2\sum x_i x_j}{(\sum x)^2} \quad (i \neq j.\ i \text{ and } j \text{ run over a, b, } \ldots)$$

This quantity is always greater than zero.

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[1] $\sum x^2$ and $(\sum x)^2$ are taken before addition of the new firm. The size of the new firm is $k\sum x$.

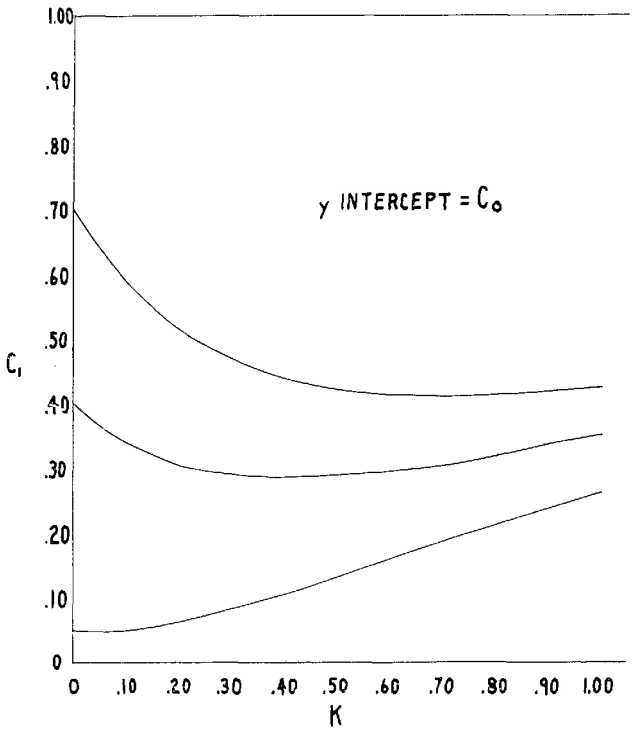
$$C_1 = \frac{\sum x^2 + k^2(\sum x)^2}{(\sum x + k\sum x)^2} = \frac{\sum x^2/(\sum x)^2 + k^2}{(1 + k)^2} = \frac{C_o + k^2}{(1 + k)^2}$$

$$\frac{dC_1}{dk} = \frac{2k - 2C_o}{(1 + k)^3} = 0, \text{ which gives } k = C_o.$$

The second derivative is positive, so this is a minimum.

FIG. 6

EFFECT ON C OF ADDING A FIRM TO AN INDUSTRY WITH AN INITIAL C_o



(SIZE OF ADDED FIRM EXPRESSED AS A FRACTION OF PREVIOUS INDUSTRY OUTPUT)

Perhaps some hypothetical distributions will make clearer the meaning of C. In Table 1, there are three distributions which yield a C of 0.25 and three with a C of 0.50. The outputs of the firms are expressed as fractions of the industry output. This table illustrates the changes that must take place in the distributions if C is to remain unchanged as N increases.

TABLE 1

HYPOTHETICAL DISTRIBUTIONS WITH
C's OF 0.25 AND 0.50

C	.25			.50		
Number of Firms in Industry	4	10	10	2	5	10
Firm No. 1	.25	.40	.45	.50	.65	.67
2	.25	.25	.13	.50	.27	.22
3	.25	.13	.10	-	.065	.045
4	.25	.08	.09	-	.01	.01
5	-	.05	.08	-	.005	.01
6	-	.03	.06	-	-	.01
7	-	.02	.03	-	-	.01
8	-	.02	.03	-	-	.01
9	-	.01	.02	-	-	.01
10	-	.01	.01	-	-	.005
Total	1.00	1.00	1.00	1.00	1.00	1.00

If C is given, there are definite limits to the size of the largest firm's output. Its output cannot lie outside the limits C and $\sqrt{C}$. These limits are shown in Table 2. If the output of the largest firm is less than C, then even if the next $(1/C - 1)$ firms closely approach the size of the largest, the sum of the outputs squared will be less than C, which is impossible. If the remaining firms are smaller than the largest, the same is true *a fortiori*. The reason for the upper limit on the size of the largest firm is obvious.

TABLE 2

LIMITS FOR LARGEST FIRM'S OUTPUT,
GIVEN C

C	Output of Largest Firm/Industry Output	
	Minimum	Maximum
.01	.01	.10
.05	.05	.22
.10	.10	.32
.20	.20	.45
.30	.30	.55
.40	.40	.63
.60	.60	.77
.80	.80	.89

Given C and the size of the largest firm, there are analagous limits to the size of the second firm, and similarly for all the firms. These limits move closer together as we proceed to smaller firms. That is to say, C is largely determined by the distribution of outputs among the larger firms. This follows from the definition of C as a weighted average; the outputs of the larger firms have the greater weights.

For example, consider a distribution of outputs (expressed as fractions of industry output) running .50, .25, x_3, x_4, ...x_n. The most C could be is .375, which would be approached as the output of x_3 approaches .25 and the outputs of the remaining firms approach zero. The least C could be is .3125, which is approached as the outputs of x_3 .....x_n approach zero.

APPENDIX II TO CHAPTER I

IS CONCENTRATION GREATER THE FINER THE PRODUCT CLASSIFICATION?

With the meaning of concentration restricted to inequality, the conclusion that concentration is greater the finer the product classification may seem to be "obviously" true, but closer examination will show that it is not necessarily true. In the following argument, concentration is taken to mean inequality, and inequality will be measured from the Lorenz plot. That is, inequality is defined as the ratio of the area between the "line of equality" and the Lorenz curve to one-half the area of the whole square. Measuring total outputs of the firms in a given "industry" by value, construct the cumulative distribution of output and number of firms. From this a Lorenz curve can be made. The inequality present in this "total" distribution is the result of inequalities present in the distributions of the separate products.

The inequality of the total distribution is the weighted arithmetic mean of the inequalities of the product distributions, the weights being the total value of each product for all firms in the industry. For this statement to be true, the firm outputs for each product must be cumulated in the same order as given by the "total" distribution. The product distribution which is relevant to the calculation of the average is not necessarily the one in which the firms' outputs of the individual product are cumulated from lowest to highest.

A reversal is defined as the case in which a higher output is cumulated before a lower one when outputs of a particular product are cumulated in the order given by the "total" distribution. The distribution of outputs for a

given product (and the corresponding "Lorenz" curve) when outputs are cumulated in this way will be designated as "the distribution with reversals," whether or not reversals actually occur. The distribution of outputs when outputs are cumulated from lowest to highest will be designated as the "distribution without reversals."

The proposition that L_T is the weighted arithmetic mean of the L's for separate products applies to distributions with reversals. If, however, there are no reversals, then the distributions with and without reversals are the same. Hence in this case the inequality of some of the product distributions will be less than the inequality for the "total" distribution and some will be higher, the particular number depending on the level of the inequalities in the product distributions and the weights attached thereto. The requirement that the output ranks of the firms be the same for each product still leaves room for the output ranks of the products within each firm to differ.[1]

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[1]The proposition that the inequality of the "total" distribution is a weighted average of the inequalities of the separate product distributions is here proved for two products.

It can be shown that inequality (designated by L), as measured from the Lorenz curve,

$$= \frac{(n-1)\sum_{i=1}^{m} x_i - 2\sum_{j=1}^{m-1}\sum_{i=1}^{j} x_i}{n\sum_{i=1}^{m} x_i}$$

where n is the number of firms and x_i is the output of the i'th firm.

The firms in the industry make two products, A and B. Total product is designated by T. x is value of product. $T^{x_i} = A^{x_i} + B^{x_i}$. Bear in mind that the outputs of A and B are cumulated by their positions in the "total" distribution.

For total firm outputs,

$$L_T = \frac{(n-1)\left[\sum_{i=1}^{m} A^{x_i} + \sum_{i=1}^{m} B^{x_i}\right] - 2\sum_{j=1}^{m-1}\sum_{i=1}^{j} T^{x_i}}{n\sum_{i=1}^{m} T^{x_i}} .$$

Next, note that

$$\sum_{j=1}^{m-1}\sum_{i=1}^{j} T^{x_i} = \sum_{j=1}^{m-1}\sum_{i=1}^{j} A^{x_i} + \sum_{j=1}^{m-1}\sum_{i=1}^{j} B^{x_i} \text{ , since the position of the firms is the same}$$

But reversals may actually be present in the distribution with reversals. They will be present if the firms specialize on different products to the extent that the output of product A of some firm is greater, absolutely, than the output of A for a firm with a larger total output. Specialization relative to the total outputs of the separate firms is not sufficient to produce reversals, although if reversals are present there will be specialization relative to total firm outputs. If reversals are present, the area between the line of equality and the "Lorenz" curve for the distribution with reversals must be less than the area between the line of equality and the Lorenz curve for the distribution without reversals. This follows because this area diminishes as the sum of the differences between each output and "higher" outputs diminishes. Hence, if reversals are present, some higher outputs are now actually cumulated before some lower outputs in the distribution

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in the cumulative distribution for total output and in the distributions for each of the products. Making use of this, it is easy to show that the weighted arithmetic mean of inequalities for the product distribution is equal to L_T, where weights are the total value of output for each product:

$$\frac{\sum_{i=1}^{m} A^{x_i}(L_A) + \sum_{i=1}^{m} B^{x_i}(L_B)}{\sum_{i=1}^{m} T^{x_i}}$$

$$= \left(\sum_{i=1}^{m} A^{x_i}\right)\left[\frac{(n-1)\sum_{i=1}^{m} A^{x_i} - 2\sum_{j=1}^{m-1}\sum_{i=1}^{j} A^{x_i}}{n \quad A^{x_i}}\right]$$

$$+\left(\sum_{i=1}^{m} B^{x_i}\right)\left[\frac{(n-1)\sum_{i=1}^{m} B^{x_i} - 2\sum_{j=1}^{m-1}\sum_{i=1}^{j} B^{x_i}}{n \sum_{i=1}^{m} B^{x_i}}\right] \Big/ \sum_{i=1}^{m} T^{x_i}$$

$$= \frac{(n-1)\sum_{i=1}^{m} T^{x_i} - 2\sum_{j=1}^{m-1}\sum_{i=1}^{j} T^{x_i}}{n \sum_{i=1}^{m} T^{x_i}} = L_T \text{ , as above.}$$

with reversals, and it follows that the sum of the differences must be less. It may even be less than zero, which would be represented graphically by a curve with reversals lying at least in part above the line of equality. It follows from this that the inequality of more product distributions without reversals may be greater than the inequality in the total distribution, and it is possible for all of them to be greater. To summarize, the common assertion of greater inequality (concentration) for separate products must be true only if reversals are present in sufficient force.

CHAPTER II

CHANGES IN CONCENTRATION OF PIG IRON AND STEEL INGOT CAPACITY

In most industries it is difficult to obtain useful data on a company basis for any fairly long period. In the case of iron and steel, however, there has been a trade association in existence for a very long period. Much of this association's statistical data on operations has but little relevance to the problem of concentration because it deals with the industry as a whole rather than with separate firms. But the data on pig iron and steel ingot annual capacities to be found in the various issues of the directory of the American Iron and Steel Association (later the American Iron and Steel Institute) bear directly on the problem at hand.

Distributions of annual capacity by firms for pig iron and steel ingots have been compiled for the years 1898, 1904, 1908, 1916, 1920, 1930, 1938, 1945, and 1948. For steel ingots it is also possible to approximate a complete distribution for the year 1940. From these distributions, three measures of "concentration" have been computed: first, the measure proposed in the previous chapter, which measure reflects both the number of firms in the industry and the coefficient of variation of the distribution of capacities and will be designated by C; second, the Gini measure of inequality represented graphically by a ratio of certain areas on a Lorenz plot; and third, the measure used by Crowder in The Structure of Industry, the per cent of total output (in the present case capacity) that is controlled by the four top firms in the distribution, this measure to be designated by Cr.

Examination of concentration in capacity does not provide, of course, a truly close link with actual operating results of the industry. Over any

short period of time, change in the distribution of capacity is far too sluggish to give indication of changes in competitive relationships. Over longer periods, however, capacity is more trustworthy provided we are content to measure broad changes. A study of these distributions over the past half century should permit a fairly good answer to the question of whether concentration has increased or decreased, although the more difficult question of the intensity of competition over the same period will require close examination of other factors in addition to those included in the concept of concentration.

The data are taken from the Directory of Iron and Steel Works of the United States and Canada, which has been compiled at various intervals by the American Iron and Steel Association. Charcoal furnaces are included in pig iron capacity, but at no time in the period covered were they of much importance. Since the data are presented on essentially an establishment basis, fortunately with the company name, scattered holdings had to be combined. The extent of a company's holdings was determined by following decisions of the directory's compilers. Cases of control by minority holdings seem to be few in number. The number of active firms is not a completely definite quantity. The doubtful cases involve firms in the hands of receivers; there have been a fair number of these cases in pig iron, especially among the charcoal furnaces, quite a number of which lingered on even into the period under study. Their capacities are so small, however, that our results are hardly affected, except for the number of firms. It is a still more difficult task to determine whether a certain furnace is alive or dead than whether a firm is alive or dead. The directory purports to list "active" equipment, but a small amount of it at any given time has simply not yet been pronounced dead. Idleness of equipment for a year or two, or even "several" years is not a

sufficient reason for exclusion from the directory. In some years equipment that has been inactive for so many years that there is a presumption of death is designated in the directory by parentheses around the last year of operation. This equipment was assumed to be dead. With this exception, the active list has been accepted for what it purports to be. To get some idea of how important the treatment of this moribund equipment was to the results, a distribution was prepared for pig iron capacity in 1898 based on a narrower definition of active capacity, the requirement being operation of the equipment in 1897 or 1898. Changes in the three measures of concentration were minor. There is also some offset in the fact that larger firms make mistakes as well as small ones. Some of the former's equipment dies a lingering death which does not immediately get recorded, so that the error from including some dead works is not confined to one end of the distribution.

For steel ingots, all ingot capacity is included whether open hearth, Bessemer, or other. Steel for castings has been excluded when produced by firms making steel exclusively for castings. For 1904 a distribution was prepared including the capacity of firms making steel only for castings. As compared with the distribution excluding such firms, this inclusion produced a small but perceptible change in the concentration measures because the number of such firms is not small. The Gini measure of inequality is independent of number if that is all that is altered in a distribution, but elimination of castings firms, which fall at the lower end of the distribution, alters the shape as well as number and consequently changes this measure of inequality.

For 1940, the three measures can be closely approximated from data on steel ingot capacity of the eighteen top firms in 1945 prepared by the Smaller

War Plants Corporation.[1]

The compilers of the Directory have not seen fit to include a discussion of their concept of capacity. One desideratum is that the definition used be consistently applied to all firms in the industry and to all years. There is no positive evidence that this has been the case, but the long history of the Association and of the Directory should contribute to consistency over time, and the widespread use of the capacity concept in the industry should contribute to its consistent application in different firms. It should be stressed that this chapter is concerned with capacities in pig iron and steel. These data do not give direct indication of the overall success of the firm, as measured by profits, nor do they indicate the extent of concentration in particular products requiring further fabrication.

A coefficient of concentration can give some indication of the degree of monopoly in Lerner's sense, but the two are not equivalent. Whether the makers of "basic" products further fabricate them themselves or sell them to other firms for further fabrication, the degree of monopoly, according to Lerner's analysis, cannot be less for the whole chain of processes than it is for the highest degree of monopoly in any one stage except in the unusual circumstance where marginal cost exceeds price by a sufficient amount at some process stage.[2] Although a concentration index will indicate the likelihood

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[1]J. M. Blair, H. F. Houghton, and M. Rose, Economic Concentration and World War II, a report of the Smaller War Plants Corporation to a special Senate committee to study problems of American small business (Washington: Government Printing Office, 1946), p. 84.

[2]It will be recalled that in Lerner's scheme, the degree of monopoly for several stages taken together is equal to one minus the product of the quantities MC/P for each of the stages. If, at the "basic" stage, MC/P is less than one, the final product will be no larger than this if MC/P at each successive stage is one or less. See A. P. Lerner, op. cit.

of successful cooperative action, it will not indicate the degree of monopoly for the industry nor for particular products, but instead will point to only a minimum level of monopoly power if Lerner's analysis of the multiple stage problem is accepted.

But Lerner's analysis of this problem is inconsistent with his concept of monopoly power and with his fundamental measure, (P-MC)/P, which involves the discrepancy between price and (social) marginal cost. Consider a Cournot mineral spring under control of a monopolist. Marginal cost is zero. He sells his water to firms in a second stage of production. These firms are competitive and have a positive marginal cost. According to Lerner, the degree of monopoly for the two stages together is equal to $\frac{P_1 - P_1 \cdot \frac{MC_1}{P_2} \cdot \frac{MC_2}{P_2} \cdots}{P_1}$

$= 1 - \frac{MC_1}{P_1} \cdot \frac{MC_2}{P_2} \cdots = 1 - (1 \times 0) = 1$, where P_1 is the final price. But this result is inconsistent with viewing monopoly power as a matter of the discrepancy between price and marginal cost. Combining the two stages, marginal cost is not zero. Therefore, the degree of monopoly for the combined stages should not be equal to one.

A measure of monopoly power for several stages that is consistent with Lerner's fundamental notion of monopoly power is

$$M = \frac{P_n}{P_1} \cdot M_n + \frac{P_{n-1}}{P_1} \cdot M_{n-1} + \cdots\cdots + \frac{P_1}{P_1} \cdot M_1 \quad ,$$

where M is monopoly power for all stages together. That is, overall monopoly power is equal to the sum of the monopoly powers at each of the stages, with each one scaled down by the ratio of price at that stage to final price. In the mineral spring example, if the monopolist sells for ten, the competitors' marginal cost is twenty (including ten paid to the monopolist), and the final

price is twenty, this formulation gives $M = \frac{20}{20} \cdot 0 + \frac{10}{20} \cdot 1 = \frac{1}{2}$. This is consistent with Lerner's fundamental definition, (P - MC)/P. "Social" marginal cost is clearly ten, which gives one-half for monopoly power when inserted in the definition.

The revised formulation means that monopoly power for all stages may be greater or less than monopoly power as indicated by examination of only one stage. The more competitive the later stages, the more likely it is that any notions on the degree of misallocation derived from examination of an early stage should be scaled down. The difficulty in Lerner's procedure discussed earlier is similar to the duplication involved in the concept of value of products as compared with value added. To what extent are the widespread impressions of monopoly's great importance in our economy due to this neglect of "value added"?

In calculating the measures of concentration, no attention has been paid to the size of the market in a geographical sense. Since all the firms do not sell products in the identical markets, the calculated measures of concentration may be below some of the coefficients that would be secured if markets were more narrowly defined. In the case of C, it cannot be higher for several regions combined than the highest C for a separate region. The combined C may be lower than all the C's for separate regions. Hence it cannot be said on a priori grounds that the level of the combined C will be misleadingly low. The bias over time seems to be clearly in the direction of an overestimate of concentration in later years because of reductions in the cost of transportation and the growing density of firms which must have brought them into closer contact with each other. "True" concentration will have risen less or fallen more than these data show.

Findings for Pig Iron

Before examining the behavior of the three measures of concentration, the distributions and number of firms will be shown directly.

From 1898 to date, the number of firms producing pig iron has clearly diminished, although even for the small number of years for which data are here presented it is evident that this decline has not been steady.

TABLE 3

NUMBER OF "ACTIVE" FIRMS MAKING PIG IRON IN THE U.S.

1898	238	1920	141
1904	186	1930	62
1908	160	1938	52
1916	132	1945	33
		1948	32

A substantial part of this decline is attributable to the exit of very small firms, many of which used charcoal furnaces.

During the period 1916 to 1920 the downward movement in the number of firms was reversed, no doubt reflecting the war prosperity of this industry. The increase in the number of firms during World War I was much greater for firms making steel ingots.

In comparing the number of firms in pig iron and steel, the increasing importance of scrap in steel manufacture should be recognized. The larger decline in the number of firms making pig iron is not attributable entirely, for example, to a greater development of scale economies in pig iron manufacture than in steel. A part of the larger decline in the number of firms making pig iron is attributable to the increased use of scrap in steel manufacture after 1900. During the same period, the ratio of pig iron to steel

TABLE 4*

RATIO OF SCRAP (HOME AND PURCHASED) USED IN STEEL MANUFACTURE TO STEEL INGOT OUTPUT

1900	45%
1910-19	48
1920-29	59
1930-39	64
1940-45	62

*Based on data from the Annual Statistical Report of the American Iron and Steel Institute) and the 1948 edition of Metal Statistics (New York: American Metal Market), p. 231.

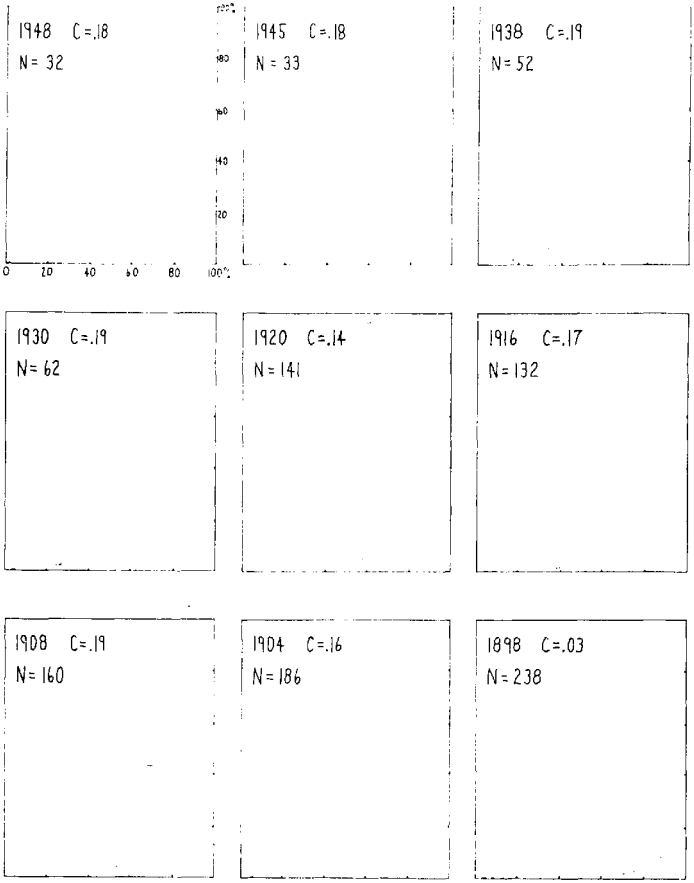
output has moved steadily downward. From 1901 to 1905, this ratio was ninety odd per cent. From 1926-35, the ratio was somewhat above sixty per cent, with an increase to the upper sixties during the next ten years.

In spite of the decrease in the number of firms, the shape of the distribution of capacity has so changed as to produce no significant change in the level of concentration as measured by C.

For the present purpose, this type of extremely skewed distribution with a small total frequency, as compared with, say, a distribution of personal income, can be most informatively presented by the graphic representation of C. This is done in Figure 7. This mode of presentation clearly shows the relative importance of the larger firms both among themselves and to the whole industry. The number of firms also affects the pattern shown by the graphs in so far as number affects the total capacity of the industry. The graphs have been constructed to eliminate the factor of size of industry by expressing each firm's capacity as a percentage of total industry capacity. It will be recalled that C is equal to the ratio of the sum of the areas of the small

FIG. 7

CONCENTRATION IN PIG IRON
1898 TO 1948, VARIOUS YEARS*



*THE NUMERICAL DATA FOR THE DISTRIBUTIONS UNDERLYING THESE GRAPHS ARE GIVEN IN TABLE 6 IN THE APPENDIX TO THIS CHAPTER.

squares (representing squared outputs of individual firms) to the area of the enclosing square (representing industry output squared).

The formation of U. S. Steel in 1901 modified the 1898 structure profoundly. The position of the Corporation has been approximately maintained through 1948. From 1904 to 1908 it gained slightly. During the years of World War I it lost ground because of the increase in the number of small firms. The notable development over the period since 1901, however, has been the growth of the large firms in the industry relative to U. S. Steel. This development has proceeded very steadily so far as can be seen from these data.

C is reproduced in Figure 8 together with L and Cr. L is a measure of inequality based on the Lorenz curve and is independent of number and total industry capacity.[1] Cr is Crowder's measure of concentration, the capacity of the top four firms divided by total industry capacity.[2]

Aside from the change caused by the formation of the U. S. Steel Corporation, these summary measures do not give evidence of major changes in the structure of this industry over a period of nearly half a century. The visual impression is one of relative constancy. The disposal of surplus property after World War II did not cause concentration to increase. There are two questions involved in making these judgments, to neither of which a satisfactory answer can be given. First, an observed change in one of these coefficients is not to be taken at face value, for this change may be the result of transient forces whose influence, if the industry could be observed

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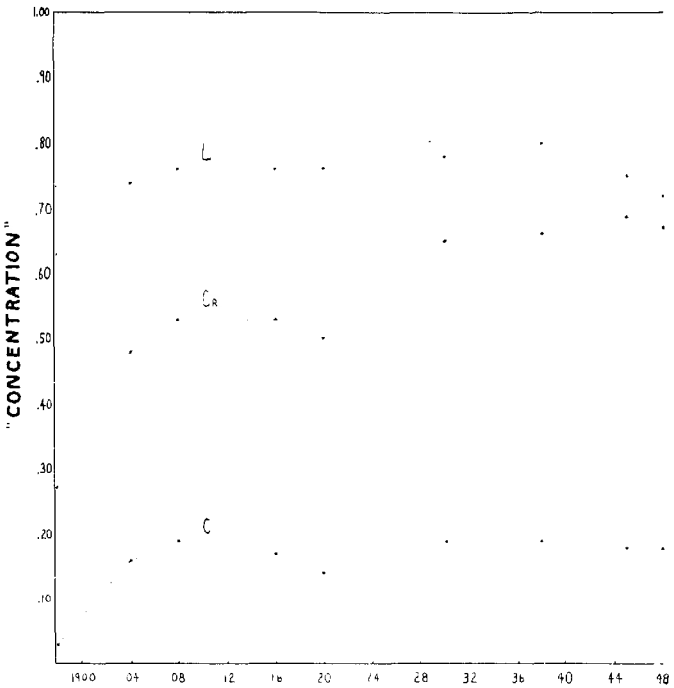
[1]Or perhaps more informatively, it is a constant multiple of the mean difference without regard to sign between every pair of members of the distribution, including self differences, divided by the mean of the distribution.

[2]Numerical values are presented in the following table:

FIG. 8

MEASURES OF CONCENTRATION IN
PIG IRON CAPACITY IN THE U.S.,
1898 TO 1948, VARIOUS YEARS



over a long period under a certain set of "permanent" conditions, would cancel out. The number of observations available here is too small to warrant even a sledge hammer attack on this problem. The second question concerns the "practical" significance of a given "true" change in any one of these coefficients. Determination of significance in this sense requires knowledge of simultaneous changes in competitive structure and market results derived from other sources. At this point it is suggested only that the major change occasioned by the formation of U. S. Steel provides a standard by which it can be said that subsequent changes in these coefficients have been small.

The principal findings on concentration in pig iron may be summarized as follows: (a) the three measures of concentration do not give indication of significant change since the formation of the U. S. Steel Corporation; (b) the companies immediately below U. S. Steel in size have grown relatively more than the Corporation; and (c) U. S. Steel's relative position (relative to the whole industry) has not moved significantly in either direction.

Steel Ingots

Unlike the number of firms making pig iron, there has been no continued

	C	L	Cr	N
1898	.03	.63	.27	238
1904	.16	.74	.48	186
1908	.19	.76	.53	160
1916	.17	.76	.53	132
1920	.14	.76	.50	141
1930	.19	.78	.65	62
1938	.19	.80	.66	52
1945	.18	.75	.69	33
1948	.18	.72	.67	32
1898	.04	.62	.32	140

For years above the double rule, all "active" firms are included, some of which were inactive in 1897 and 1898. For the year below the double rule, only firms active in 1897 or 1898 are included.

change in the number of firms producing steel ingots since 1904. From 1916 to 1920 there was an increase from 88 to 160 firms, which increase is to be explained on the basis of war stimulated demand for steel. Since some time in the 1930's, the number of firms has been about one-half of the post World War I peak. The distributions of capacity, together with C and the number of firms, are shown in Figure 9.

From these graphs it may be seen that the formation of U. S. Steel produced an even greater alteration in the firms' relative capacities for steel ingots than for pig iron. Over the years following its formation, U. S. Steel's share of ingot capacity declined until by 1930 it reached the level at which it remained through 1948. Throughout the whole period, with the exception of 1916 to 1920, the relative capacities of the larger firms immediately below U. S. Steel have steadily increased until by 1948 the discrepancy between them and U. S. Steel was far less than in 1904.

The net result of these changes has been a decline in C from 1904 until a few years after World War I. Since that time, C has remained on approximately the same level. Cr and L, however, have remained at about the same level over the whole period. The three measures over this period are shown in Figure 10.[1]

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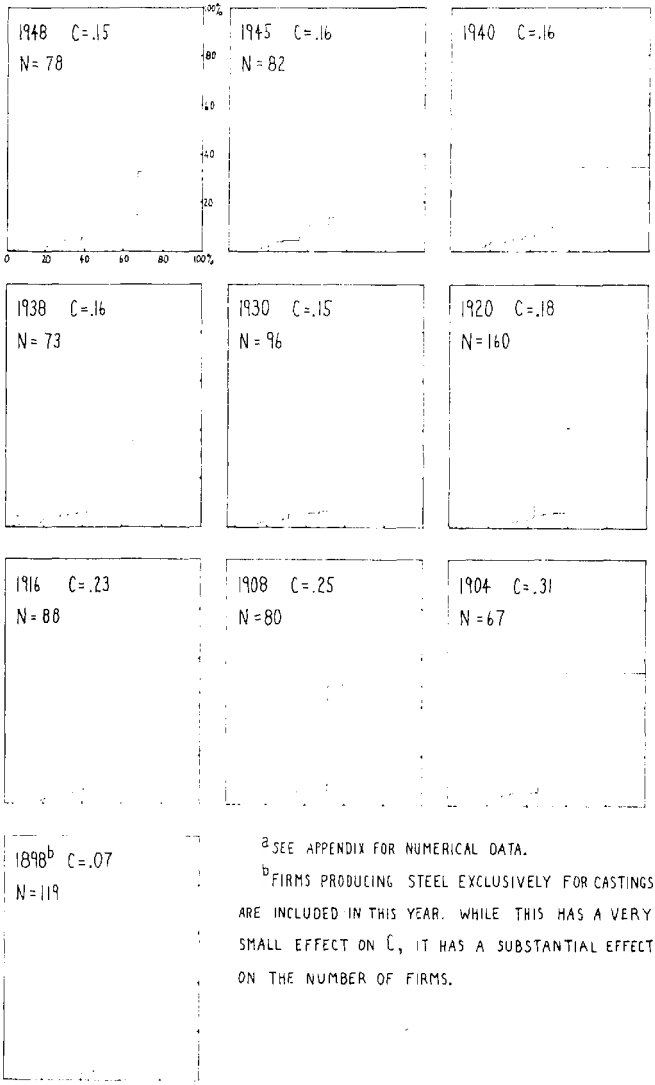
[1]Numerical values for Figure 10 are as follows:

	C	L	Cr
1948	.15	.83	.62
45	.16	.85	.64
40	.16	.83	.64
38	.16	.84	.63
30	.15	.86	.58
1920	.18	.86	.57
16	.23	.85	.65
08	.25	.84	.65
04	.31	.85	.69
04	.30	.90	.67
1898	.07	.78	.42

In the years below the rule, firms producing steel for castings only are included.

FIG. 9 — CONCENTRATION IN STEEL INGOT CAPACITY IN THE U.S., 1898 TO 1948, VARIOUS YEARS[a]

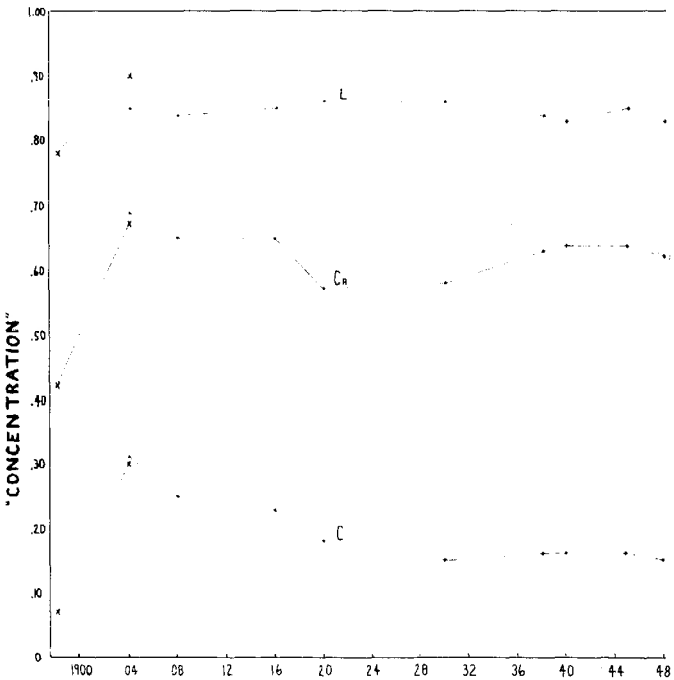


[a] SEE APPENDIX FOR NUMERICAL DATA.

[b] FIRMS PRODUCING STEEL EXCLUSIVELY FOR CASTINGS ARE INCLUDED IN THIS YEAR. WHILE THIS HAS A VERY SMALL EFFECT ON C, IT HAS A SUBSTANTIAL EFFECT ON THE NUMBER OF FIRMS.

FIG. 10

MEASURES OF CONCENTRATION IN STEEL INGOT CAPACITY IN THE U.S., 1898 TO 1948, VARIOUS YEARS[a]



[a] x POINTS INCLUDE FIRMS PRODUCING STEEL FOR CASTINGS ONLY.

• POINTS EXCLUDE THESE FIRMS.

The significance of changes in C may be made clearer by considering the approximate number of firms with equal outputs that would leave C at its actual level for the year in question.

TABLE 5

NUMBER OF FIRMS WITH EQUAL OUTPUTS REQUIRED TO LEAVE C FOR STEEL INGOTS UNCHANGED

1898	14	1938	6
1904	3	1940	6
1908	4	1945	6
1916	4	1948	7
1920	6		
1930	7		

As measured by C, concentration has declined since the formation of U. S. Steel. Crowder's measure, neglecting relationships among the four top firms and also among the remaining firms in the distribution, indicates that concentration in 1948 was slightly lower than it was after the formation of U. S. Steel. L, a measure of inequality exclusively, exhibits approximate constancy throughout the whole period. Both C and L for 1940 were estimated on the assumptions that the number of firms remained constant from 1938 to 1940 and that the unknown capacities of the smaller firms (beyond the sixteenth for 1940) form an arithmetic progression with the capacity of the smallest firm equal to the constant difference.

In summary, the data presented here lend no support to the view that concentration in either pig iron or steel ingot capacity has increased since the formation of U. S. Steel. If anything, the situation in steel ingots has improved. These statements should not be interpreted as implying that competition in these two fields is at a satisfactory level of intensity. These data are of little aid in dealing with that issue.

The Effect of Exports and Imports

Foreign trade in iron and steel products has been but a small portion of domestic production for many years. Hence, a procedure that attempts to describe the industry structure in a simple way with a view to its connection with the price outcome, very little correction is called for. This conclusion is subject to a qualification indicated by a preceding remark, however. It was stated that a measure of concentration in the production or production capacity of narrowly defined products will probably be misleadingly high because the more narrowly product x is defined the easier it will be for producers of related products to shift to the production of x should its producers succeed in raising price sufficiently above the competitive level. This is, of course, the factor of potential competition that writers on monopoly problems have cited for a very long time. In a multiple product industry the influence of potential competition would seem to be greater than for single product industries where the potential competition must come from outside. In steel, for example, an important part of the productive process is common to a variety of products. This lessens the cost of shifts in the composition of output and means that the producers of product x must constantly keep in mind the reactions of those not now making x but who could easily do so. The same qualification is applicable in the case of imports. The existing volume of imports may give a misleading impression of their importance in determining the domestic price outcome. It appears, however, that in the iron and steel industry this danger is not very great.

The nature of the modification in a concentration index that should be made because of imports seems fairly clear, bearing in mind that only actual imports can be taken into account. The purpose of a concentration index presumably is to cast up a summary measure to indicate the likelihood

of domination of the industry by one or a few firms or to show the likelihood of cooperative action, tacit or otherwise. If the industry has import competition, the nature of that competition will determine the modification in the measure of concentration that should be made. If the foreign firms are not in league with each other and these firms take U. S. prices as given, they should be treated as firms with minute outputs. That is, in the index, $C = \Sigma x^2/(\Sigma x)^2$, imports will affect the size of the denominator but not the numerator. If, on the other hand, the foreign firms are united, total imports should be treated as the output of one firm, affecting both numerator and denominator.

In the case of domestic firms that export a part of their product, it is doubtful that the concentration index should be modified. Because productive capacity used for export may be easily turned to the domestic market, no modification is called for, since coercive or "leadership" power would seem to be affected by total capacity, whether used for domestic or foreign sales. In addition, foreign production also should be included in the calculation of the index because the market extends beyond domestic boundaries. But if the export market is favored by price discrimination and there are domestic barriers to foreign products, foreign production for export markets should not be included in the calculation of the index if it is to indicate the domestic price outcome. Of course, the index itself is supposed to answer these questions and its method of calculation cannot depend on the implication of the index. This serves to emphasize the fact that a simple index of concentration based on a few factors (in the present case, two) will misrepresent, to some extent, situations whose outcome is actually dependent on many factors.

Actual imports classified as iron and steel products have been small relative to domestic production. The heaviest year in the period from 1911 to 1947 was 1926, when 997,000 gross tons of semifinished and finished iron and steel products, pig iron, and alloys were imported. In most years this total was much lower.[1] U. S. production of ingots was much larger, running over twenty million tons in every year except 1932 and usually much more than this.

It has been suggested that the threat of import competition may have a greater effect on domestic price than is indicated by the actual volume of imports. It seems unlikely that this is true of the iron and steel industry. Substantial tariffs have been in effect on iron and steel products over the whole period under consideration and, of course, were in existence long before the beginning of the twentieth century.[2] Some of the tariffs are undoubtedly ineffective in that even if they were removed entirely, imports of these products would not increase significantly, assuming steel products were free to move out of foreign countries. James judges that duties "appreciably"

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[1]For these data, see the various issues of the Annual Statistical Report of the American Iron and Steel Institute.

[2]C. L. James (TNEC Monograph No. 10, Industrial Concentration and Tariffs, p. 23), who investigated twenty-seven "products" of the iron and steel industry, summarized his findings on the level of duties as follows:

Per cent of products (value basis)	Duty to which subject (ad valorem basis)
4%	60% and over
28	30-59
68	0-29

Compare the statement in the U. S. Tariff Commission's Iron and Steel (Report No. 128, 1938 /Washington: Government Printing Office/ p. 14) to the effect that U. S. tariffs on iron and steel products run mainly from ten to thirty-five per cent on an ad valorem equivalent basis.

restrict imports of sixty per cent (by value) of the steel products he studied.[1] The U. S. Tariff Commission, in a 1938 publication, stated that internal price levels in European producing countries were "somewhat" lower than internal steel products prices in the U. S.[2] European products must overcome tariff and transportation barriers, and the transportation barriers to the interior of the United States from ports are more significant than ocean barriers. If European pre-war prices were ordinarily close to U. S. prices, it would seem unlikely at first glance that the threat of imports could have been of much importance in deterring U. S. producers from raising prices. But the possibility of price discrimination by foreign producers between their home markets and the U. S. market might make import competition an actual threat even though domestic prices for steel and the barriers would indicate otherwise.

Even if cost relationships and the other barriers were such as to permit considerably higher imports if U. S. prices were higher, imports still might not have increased because of agreements between U. S. exporters and foreign producers reserving U. S. markets for domestic producers. Such agreements have always been illegal under the Sherman Act and they continued to be illegal under the Webb-Pomerene Act of 1918. This act made legal concerted action by domestic producers for the purpose of exploiting foreigners, which is to say that U. S. firms are permitted to act together for the purpose of "stabilizing" export trade. If they made use of this opportunity, however, they were not permitted to abridge competition in the United States, and, of course, any agreements with foreign producers which limited competition in the United States were forbidden. Consequently, there is very little publicly

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[1]James, op. cit., p. 23. [2]Tariff Comm., op. cit., p. 17.

available evidence of such agreements between domestic and foreign producers, if they have existed at all.

According to the U. S. Tariff Commission, U. S. producers participated in the following international cartels: rails, 1909-14 and 1926 on; pipe and tubes, 1928-35; tin plate, after 1934; wire products, after 1932 (U. S. producers had an agreement with this group but did not join it); and an agreement with the International Steel Export Cartel, after 1933.[1]

This list can be extended on the basis of testimony before the TNEC. After 1935, there was an informal understanding between U. S. exporters (i.e., those who were members of the Steel Export Association of America) and European producers which maintained prices but did not involve quotas and penalties. On certain goods the usual agreements were in effect. In rails, for example, the last agreement covered in this testimony ran until 1940. In 1937 an agreement was negotiated with the International Steel Cartel covering heavy products. The witness stated that this agreement was never actually signed, but in spite of this it apparently was in effective operation in 1938.[2]

For the record, these agreements restrict only export trade. To the outsider, however, it would seem strange if the threat by U. S. exporters to remain outside the international agreement did not secure agreement by other cartel members to stay out of the U. S. market. This result need not necessitate any sly attempt by U. S. exporters to break our law. European producers were already well coached on this point, for it was a common feature of international agreements involving export quotas, which is the main or only type of agreement in which U. S. steel exporters have participated, that the

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[1] Ibid., p. 384.

[2] TNEC Hearings, Part 20, p. 10926f.

domestic market was reserved for home producers.[1]

A stronger piece of evidence of one such understanding reserving the U. S. market for U. S. producers appears in the TNEC hearings. The heavy steel agreement, mentioned above, included a provision for a later negotiation on sheets. The U. S. members of the Export Association were having difficulty lining up other U. S. producers for this agreement. European members of the International Steel Cartel were pressing for an early agreement. In commenting on this situation, Mr. Schroeder of the Wheeling Steel Corporation wrote to the secretary of the Steel Export Association of America the following:

> Also, and more imminent, is the danger that the British and Continental parties will renounce the present tentative agreements unless they are made more satisfactorily effective. Such renunciation would inevitably be followed by an influx of low-priced foreign steel in domestic markets.[2]

This gives fairly clear indication of a tacit agreement, at least, for Europeans not to invade the U. S. market. On the next two pages of the hearings, Mr. Schroeder denies that the prospect of reduced foreign competition in the U. S. market ever encouraged agreements with the International Steel Cartel.

It is true that international agreements have not been continuously in operation and that United States participation has been even more irregular. All the same, the suggestion conveyed by import statistics that import competition has played but a small part in the U. S. steel market is strengthened by consideration of the likely effects of the international agreements.[3]

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[1] U.S. Tariff Commission, op. cit., p. 377 and TNEC Hearings, Part 20, p. 10931.

[2] TNEC Hearings, Part 20, p. 10950.

[3] The reader will understand that the phrase "international agreements" as used here does not refer to agreements between governments but to agreements between producer groups of various countries.

APPENDIX TO CHAPTER II

TABLE 6

PARTIAL ARRAYS OF PIG IRON CAPACITY IN THE U.S. BY FIRMS FOR SELECTED YEARS FROM 1898 to 1948[a]

1948	1945	1938	1930	1920	1916	1908	1904	1898
36.7%	36.7%	39.9%	40.2%	36.4%	39.4%	43.2%	38.7%	11.5%
14.5	14.3	12.8	13.6	5.6	5.9	3.7	3.5	7.7
9.5	9.5	7.4	6.1	4.3	4.1	3.2	3.2	5.5
6.1	6.1	6.1	5.7	4.2	4.0	3.0	3.0	2.5
5.2	5.2	5.5	4.1	3.0	3.1	2.7	2.3	2.3
4.4	4.4	4.1	3.7	2.9	2.8	2.6	2.2	2.0
4.4	3.4	2.6	2.0	2.2	1.8	1.8	2.1	1.9
2.3	2.4	2.4	1.9	2.2	1.4	1.4	1.7	1.9
1.9	2.2	2.0	1.1	2.1	1.2	1.2	1.5	1.8
1.9	2.0	1.3	1.0	1.2	1.2	1.0	1.4	1.6
1.3	1.9	1.3	1.0	1.2	1.2	1.0	1.2	1.5
1.1	1.2	1.1	1.0	1.2	1.1	1.0	1.2	1.3
1.1	1.1	1.0	1.0	1.0	1.1	.9	.9	1.3
.8	.8	.9	.9	1.0	.9	.8	.9	1.3
.8	.8	.9	.9	1.0	.8	.8	.8	1.2
.8	.8	.9	.9	1.0	.8	.8	.7	1.2
.8	.8	.8	.9	1.0	.8	.8	.7	1.2
.7	.7	.8	.8	.9	.7	.8	.7	1.1
.7	.7	.8	.8	.9	.7	.7	.7	1.0
0.7	0.7	0.8	0.8	0.7	0.7	0.7	0.7	0.9
Industry capacity 100%	100%	100%	100%	100%	100%	100%	100%	100%
Total No. of firms 32	33	52	62	141	132	160	186	238

[a]Compiled from various issues of American Iron and Steel Institute's Directory of Iron and Steel Works of the United States and Canada.

TABLE 7

PARTIAL ARRAYS OF STEEL INGOT CAPACITY IN THE U.S. BY FIRMS FOR SELECTED YEARS FROM 1898 TO 1948[a]

1948	1945	1940[b]	1938	1930	1920	1916	1908	1904	1898
35.2%	35.2%	34.1%	35.3%	33.4%	41.0%	45.9%	48.7%	54.3%	19.6%
14.6	13.5	14.1	13.7	13.5	5.7	7.5	5.4	4.9	12.8
9.1	10.3	9.6	8.9	6.0	5.2	5.9	5.3	4.6	4.7
5.0	5.3	6.0	5.1	5.3	4.8	5.7	5.1	4.6	4.7
4.3	4.2	4.7	4.6	5.1	3.4	3.8	4.7	4.2	4.5
4.2	4.1	4.3	4.3	5.0	2.7	2.9	3.8	3.4	3.6
3.6	3.6	3.8	3.8	3.1	2.5	2.8	2.3	2.3	3.6
3.6	3.4	3.7	3.5	2.6	2.1	2.5	1.9	2.1	2.9
1.7	2.1	2.4	2.4	2.6	1.8	2.2	1.9	1.5	2.7
1.5	1.6	1.4	1.3	1.9	1.6	1.8	1.5	1.3	2.2
1.5	1.3	1.3	1.2	1.6	1.4	1.2	1.3	1.2	2.2
1.3	1.1	1.2	1.2	1.6	1.3	1.2	1.1	1.1	2.2
1.2	1.0	1.1	1.2	1.5	1.2	1.1	1.1	1.0	2.0
1.1	.9	.9	1.1	1.4	1.1	1.1	.9	.8	1.4
1.0	.8	.9	.9	1.1	1.1	1.0	.8	.8	1.4
.9	.7	.6	.9	1.1	1.1	.9	.8	.6	1.4
.8	.7	'	.9	1.0	.9	.6	.8	.6	1.4
.7	.7	'	.7	.8	.8	.5	.7	.6	1.2
.7	.6	'	.7	.8	.8	.5	.7	.6	1.2
0.6	0.6	'	0.5	0.7	0.8	0.5	0.7	0.5	1.1
Industry capacity 100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Total No. of firms 78	82	73[c]	73	96	160	88	80	67	---

[a]Compiled from American Iron and Steel Institute Directory.

[b]Blair, Houghton, and Rose, op. cit., p. 84.

[c]Assumed to be same as in 1938.

CHAPTER III

REGIONAL CHANGES IN CONCENTRATION

When sizeable transportation charges for either raw materials or finished products are involved, as is the case with steel products, examination of the size structure of firms without reference to location will be misleading to some extent unless raw material locations and transportation charges are such as to result in the concentration of production in one area. In general, introduction of the location factor would be expected to result in a showing of greater concentration in some cases than if only nation-wide data were used. In this chapter changes in the geographical and size structure of firms' capacities for producing each of several products will be examined for the years 1904, 1938, and 1945.

Data on size and location of capacity for these groups of products are taken from the Directory of Iron and Steel Works in the United States. The number of products which can be examined in this way is limited by the makeup of the 1904 Directory. The products dealt with in this chapter include wire rod, tin and terne plate, and steel ingots. Tin and terne plate capacities for 1904 are given in number of boxes. The amount of plate contained in a box is not uniform. For these data on tin and terne plate to be as informative as the data for the other products, it is necessary that there be no relationship between size of box and size of firm.

Although no attempt is going to be made here to explain the particular origins of changes in the geographical structure of capacity, it will be useful to have in mind a general catalogue of forces affecting geographical structure. The main elements of the locational problem are the prices of

materials and of productive services, the nature of demand at various points, and transportation charges for materials and finished products.

If the density of demand at a certain point changes, there may be a change in capacity at points best adapted to serve that point, including the change from zero to some capacity. The forces behind the change in demand may be growth and development of a new region, changes in transportation facilities or rates, or the development of new industries. Secondly, the discovery and development of new sources of materials supply can alter the solution of the locational problem. The importance of innovation as a force promoting locational alteration is obvious. It may make known supplies usable which were too expensive with former processes. If the long run cost curves of firms are lowered throughout, this may be sufficient to produce some change in location, but if the advantage as between the smaller and the larger firm is changed, an additional factor making for change in the size distribution of capacity will be introduced. Lastly, when firms are not small relative to the markets served, the process of growth and decay in particular firms can alter regional concentration and an increase in the density of demand may result in growth of the existing firm or firms rather than the entrance of new firms.

As for the significance of changes in geographical structure for pricing, no very detailed conclusions are to be expected since the range of variables singled out for consideration in this chapter is limited to location, size, and numbers. In the situation in which there is neither monopoly nor enough producers at each point to insure the competitive result of geographical price differences no greater than transportation cost from point to point and with realized price equal to marginal cost, conclusions about the effect of changes in regional concentration on the price outcome must be of a general

nature. But regardless of the unusual shapes that the vagaries of transportation cost may give to market areas, the present problem can usefully be divided into two parts, each bearing on the likelihood of cooperative action. First, the extent of concentration within an area in which production is concentrated gives an indication of the possibility of common action by these firms. These firms should be considered together because the same markets are open to them, although in fact some sort of division of the market may have taken place. Second, concentration in contiguous markets should be examined, because this is relevant to what occurs in disputed market areas. If there are any costs or difficulties in coming to agreement, the incentive to cooperation will be weaker in the second case, because it will be more important to come to agreement with those firms that have more important sales areas in common. In the case of disputed market areas, a factor of importance will be the extent to which the same firm, or firms, are important producers in both areas, given the concentration coefficients in the separate regions. For example, a more competitive result is likely with the distribution of outputs in the first hypothetical case below than in the second.

	Case I			Case II		
	Region			Region		
	1	2	1+2	1	2	1+2
Firm A	4	1	5	4	4	8
B	3	2	5	3	3	6
C	2	3	5	2	2	4
D	1	4	5	1	1	2

Regional Concentration 1904, 1938, and 1945

The first product that will be considered is steel ingots.[1] The data for steel ingots probably indicate a higher degree of concentration for many

[1] In view of the impossibility of extracting data from the 1904 Directory for such product groups as rail, structural shapes, plate, and sheet,

of the categories we usually think of as steel products than is actually the case, because there are many firms that are without doubt a part of the steel industry, as it is in practice implicitly defined, that either have no ingot capacity at all or do not make all of the raw steel that they use. For some products, the degree of concentration indicated by ingots will be an understatement, because the number of their producers is quite small. On the other hand, if interest lies mainly in the question of the monopoly power underlying steel products in general, steel ingot data probably give a better indication of this than would data for products representing a higher degree of fabrication, because the sources of monopoly power in the steel industry probably lie in the earlier stages of the production process where exclusion of new entrants is easier than it is in the later fabricating stages.

Changes in regional ingot capacity will be examined first. For this purpose the country is divided into five regions which have been selected,

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an attempt was made to assemble data for the very broad category, rolled products. Such a compilation by states is to be found in both the 1904 and the 1938 Directories with total ingot capacity distributed among the various classes of products on the basis of average yields (see p. 411 of the 1938 Directory). This compilation is unsatisfactory, for from the point of view of the present problem interest lies either in finished rolled products, in the sense that there is no more rolling to be done on them, or in ingot capacity. The problem is the same as that encountered in attempting to eliminate intermediate products from a gross national product total except that here the appropriate definition of final product is different. In trying to assemble capacity data on a firm basis, the difficulty is that in some cases billets will be counted once, the same steel as bars, and perhaps again as some product made from bars, or the bars in some circumstances will be final products so far as the rolling process is concerned. Because of the impossibility of knowing whether the extent of double counting is the same in 1938 as in 1904 and because data on a firm basis cannot be made to agree with the Directories' data on a state basis, the attempt to use this broad product category was abandoned. The data, such as they were, gave results similar to those for steel ingots, bearing in mind the fact that in 1938 the number of firms in the United States with some rolling capacity was almost twice as large as the number of firms making steel ingots, excluding those firms making steel for castings only.

with the exception of the South and West, because they can be regarded roughly as areas in which production is concentrated in the geographical sense. Pennsylvania, Ohio, West Virginia, and Kentucky have been placed in one group. "Other Eastern" includes New York, New Jersey, Maryland, Delaware, and states to the northeast. The third group includes Illinois, Indiana, Michigan, Wisconsin, Minnesota, Missouri, and also Oklahoma. The "South" includes all other states as far west as Texas. The remaining states are placed in the "West" region. In fact this means Colorado, Utah, and Pacific coast states. The changes in regional capacity follow.

TABLE 8

RELATIVE STEEL INGOT CAPACITY
BY REGIONS OF THE U.S.
1904, 1938, AND 1945

Region	1904	1938	1945
Penn., etc.	72%	58%	55%
Other Eastern	11	11	10
Illinois, etc.	11	25	25
South	3	3	4
West	3	3	5
U. S.	100%	100%	99%

The important change is the growth of the Illinois-Indiana region relative to the earlier established Pennsylvania-Ohio region. That this change is indicative of an improvement in the market structure so far as the midwest is concerned is clearly revealed when changes in the number of firms and concentration coefficients are examined. The pertinent data are presented in Table 9.

In this table, the uncircled coefficient indicated by the brace is calculated for the two regions combined with ownership of plants in both regions taken account of. This coefficient cannot be larger than the larger of the

TABLE 9

REGIONAL CONCENTRATION IN U. S. STEEL INGOT CAPACITY
1904, 1938, AND 1945

Region	1904		1938		1945	
	No. of Firms	C	No. of Firms	C	No. of Firms	C
Pa., etc.	41	.40 } .33 (.31)	43	.16 } .15 (.12)	44	.16 } .15 (.13)
Other eastern	20	.24 } .35 (.26)	14	.55 } .16 (.10)	13	.53 } .16 (.10)
Ill., etc.	6	.52	19	.30	21	.24
South	5		6		10	
West	1		5		10	
U. S.	67[a]		72		82	

[a]The number of firms in the U. S. is smaller than the sum of the firms in separate regions because the same firm may operate in more than one region.

coefficients for the separate regions. It may be smaller than either of the two regional coefficients, however. This would be true, for example, if the distributions of capacity were identical in each of the regions and no firm owned plants in both regions. The adjacent encircled coefficients of concentration are computed on the assumption that no firm owns plants in both regions. The difference between the two coefficients is a reflection of the extent to which the same firm, or firms, owns plants in both regions. The difference between the two coefficients should not be thought to indicate an increase in the likelihood of cooperation over that indicated by the coefficient for the combined regions which takes account of interregional ownership, because common ownership is already reflected in this coefficient.

The total number of firms in the United States has actually increased. The important changes occurred in the Other Eastern region, where there was a decrease of about a third; in the Illinois-Indiana region, where the number increased to about three times the 1904 figure; and on the west coast where no firms had been making steel ingots in 1904 (the one firm in the West in that year was the Colorado Fuel and Iron Corporation).

Examination of the number of firms does not indicate how the relative importance of the different firms has changed, that is, whether the extent of domination has changed. In the Pennsylvania-Ohio region, C declined from 0.40 to 0.16. The proximate reason for this was the slower rate of growth of U. S. Steel relative to other firms in the region, for example, Bethlehem, Jones and Laughlin, Republic, Youngstown Sheet and Tube, Wheeling, American Rolling Mill, National Steel, etc. In the Other Eastern region, however, the concentration coefficient increased between 1904 and 1938 from 0.24 to 0.55. Although this development was accompanied by a decline in the number of firms in this region, the increase in concentration is to be attributed mainly to the formation and

development of Bethlehem with its large tonnages in Maryland and New York. Merger played an important part in its growth. In the Illinois-Indiana region, concentration declined and at the same time the number of firms increased substantially from six to nineteen. These developments are shown graphically in Figure 11. The data for 1945 produce figures very similar to those for 1938, with the exception that in the Illinois region, U. S. Steel's capacity had declined to forty-five per cent of the regional total by 1945.

The inter-regional concentration coefficients, claculated by combining two adjacent regions, also show a decline of about a half from 1904 to 1938, with no significant change from 1938 to 1945. The extent to which there was inter-regional ownership between the Illinois-Indiana and the two regions to the east fell slightly from 1904 to 1938. This is indicated by the difference between the uncircled and the encircled inter-regional coefficients.

Concentration coefficients were not calculated for the South and West because plants are widely scattered. In any case, the coefficients for the regions that ship to them are more to the point.

In summary, the size and geographical structure of ingot capacity have not deteriorated over this period. On the contrary, there has been a definite improvement.

Wire Rod

Regional changes in wire rod capacity from 1904 to 1938 have not been very great. As in the case of steel ingots, the number of firms producing wire rod has increased. No region had fewer firms producing wire rod in 1938 than in 1904, but in 1945 the Pennsylvania-Ohio region had two fewer firms than in 1938. The largest increase in the number of firms occurred in the Illinois-Indiana region. From Table 11, it may be seen that the concentration coefficients

FIG. 11

REGIONAL CONCENTRATION IN STEEL INGOTS, 1904 AND 1938

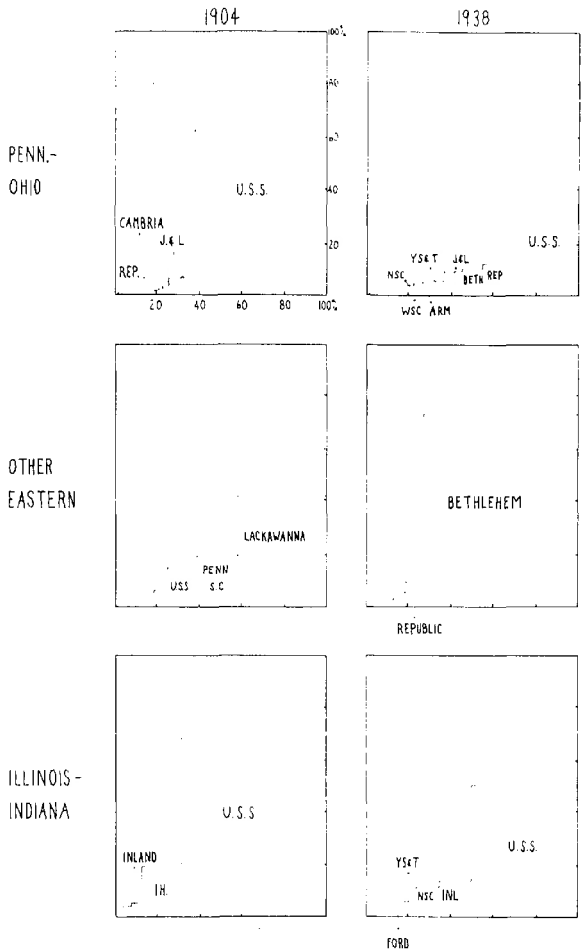

TABLE 10

RELATIVE WIRE ROD CAPACITY
BY REGIONS OF THE U.S.

Region	1904	1938	1945
Penn.-Ohio	46%	44%	36%
Other Eastern	19	18	17
Ill.-Ind.	22	30	29
South	4	6	9
West	9	2	8
U. S.	100%	100%	99%

in the Pennsylvania-Ohio and the Illinois-Indiana regions dropped from 0.68 and 0.67 respectively to 0.24 and 0.21 from 1904 to 1938, with little change to 1945. Inter-regional coefficients fell somewhat less from 1904 to 1938, but still very noticeably, with practically no change thereafter to 1945. The extent to which the same firm, or firms, dominated the adjacent regions also dropped substantially as indicated by the differences between the encircled and the adjacent uncircled values.

Tin and Terne Plate

The regional capacity for tin and terne plate of the Pennsylvania-Ohio region declined relatively from 1904 to 1938. This development continued to 1945.

Although regions outside the older producing area of Pennsylvania and Ohio have secured a larger percentage of the nation's capacity, the number of firms has diminished from a total of thirty in the United States in 1904 to but nine in 1945. In spite of this fact, concentration coefficients declined in two out of the three regions for which they are computed. In the Other

TABLE 11

REGIONAL CONCENTRATION IN U.S. WIRE ROD CAPACITY
1904, 1938, AND 1945

Region	1904		1938		1945	
	No. of Firms	C	No. of Firms	C	No. of Firms	C
Pa., etc.	7	.68	11	.24	9	.23
Other eastern	8	.18 .46 (.36)	10	.22 .19 (.14)	11	.21 .18 (.13)
Ill., etc.	3	.67 .44 (.24)	9	.21 .17 (.11)	9	.25 .17 (.10)
South	1		3		4	
West	1		2		3	
U. S.	17		28		29	

TABLE 12

RELATIVE TIN AND TERNE PLATE CAPACITY BY REGIONS OF THE U.S.

Region	1904	1938	1945
Penn.-Ohio	78%	59%	50%
Other eastern	4	12	14
Ill.-Ind.	18	23	23
South	0	5	12
West	0	1	1
U.S.	100%	100%	100%

Eastern region the concentration measure went from 0.62 to 1.0 since the number of firms operating there declined from three to one. Inter-regional concentration also declined considerably in each case. Finally, the extent to which one firm dominated adjacent regions declined noticeably. Details are given in Table 13.

Summary

From the data presented in this chapter, it cannot be concluded that the geographical-size structure has improved for every category of steel product, for these data cover only one important product and two minor ones. The findings for steel ingots are important in their own right, however. For this part of the steel industry, thought by many to be "basic" in some sense, the evidence indicates a definite improvement in the structure under study. The two minor product categories studied show improvement, the one clearly and the other less clearly. At the least, these findings serve to make dubious easy generalizations that the "steel industry," because of the economies of large scale production, has been and is becoming more monopolistic.

TABLE 13

REGIONAL CONCENTRATION IN U.S. TIN AND TERNE PLATE CAPACITY
1904, 1938, AND 1945

Region	1904		1938		1945	
	No. of Firms	C	No. of Firms	C	No. of Firms	C
Pa., etc.	22	.51 } .47	9	.17 } .14	5	.27 } .21
Other eastern	3	.62 } .48 (.33)	1	1.0 } .14 (.10)	1	1.0 } .16 (.13)
Ill., etc.	5	.56	5	.32	4	.30
South	0		1		1	
West	0		1		1	
U. S.	30		13		9	

CHAPTER IV

THE DISTRIBUTION OF VALUE ADDED AMONG FIRMS IN THE IRON AND STEEL INDUSTRY

In the preceding two chapters changes in the distributions of firm capacities for several products were examined. A better measure of the importance of the firms would be value added (or national income originating) by each firm, provided the products of the different firms are closely related. The capacity distributions are important, however, because they cover a longer period of time and more firms than does value added.

Analysis of changes in the distribution of value added could conceivably give results quite different from those based on ingot or pig iron capacity, because the ratio between "basic" and "final" productive activity could be quite different for the various steel companies. Furthermore, this relationship can change over time. For these reasons, attention to ingot or pig iron capacity alone might be misleading. In addition, value added is closely linked with actual operations. This is not necessarily true of capacity.

The Data

Value added, or national income originating, has been calculated for the eight largest steel firms as far back to 1919 as available data permitted.[1] In these estimates, value added is defined as follows:[2]

> wages and salaries (including executive salaries, social security taxes paid by the employer, current pension expense, and current cost of group insurance)

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[1] See appendix for estimates.

[2] Needless to say, the data do not always conform to these definitions. For example, net income can but rarely be had before state income taxes. Profits

+ interest paid

+ net profits (before income taxes and dividends and after interest; after renegotiation and post-war credits for carry-back)

- dividends and interest received

In a number of cases, rough estimates were made to fill gaps. This was most frequently necessary for interest and dividends received. In years for which these items were not available, they were set at or near the levels of known years. Interest and dividends received are small relative to total value added.

In a few instances wages and salaries, the most important component of value added, had to be estimated.[1] In each case the estimate was made by multiplying the number of the company's employees by the employment cost per employee for U. S. Steel. Estimates based on social security tax payments were more inaccurate, presumably because of inter-company variation in the percentage of wages and salaries over $3,000 per year.

Useful estimates of value added could not be made for the following companies and years: Inland, 1919-24; Youngstown Sheet and Tube, 1919-22; Jones and Laughlin, 1919-22; and Republic, 1919-21.

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are taken before income taxes to conform to the practice of the Department of Commerce because the data for the eight top firms will later be compared with Commerce data for the iron and steel industry.

The sources used for these estimates are as follows:

Security and Exchange Commission reports on corporations registered under the act, various years.

TNEC Hearings, Part 31, Investments, Profits, and Rates of Return for Selected Industries (A Federal Trade Commission study).

Moody's and Poor's manuals of industrial corporations.

Annual reports of the steel companies.

Some of the data were obtained by direct correspondence with the steel companies and the United Steel Workers of America.

[1]This was necessary for the following years and companies: Youngstown Sheet and Tube, 1928-42; Inland Steel, 1925-31; and National Steel Corporation, 1931.

We shall want to compare the value added by these eight top firms with the value added by the whole group of which they are members. This opens the question of how this group, or industry, should be defined. Unfortunately, there is no room for discretion. The definitions of the Department of Commerce and Simon Kuznets are controlling if it is desired to use their data, and their definitions in turn were dictated by the classifications of the basic sources of data.

The Department of Commerce series of national income originating in the iron and steel industry will be used for the years 1929 to 1948. The industry group used by Commerce includes a good deal more than what is usually understood to be the iron and steel industry. The difference is that the Commerce group includes products (or processes) constituting a much higher degree of fabrication than is usually associated with the iron and steel industry. This makes the group larger than it should be for our purposes. For example, ordnance and accessories are included here. During the war a great deal of ordnance was produced by firms having no direct connection with the iron and steel industry, although the iron and steel industry proper also produced ordnance. In peace time, ordnance is a minor difficulty. The doubtful inclusions in the Commerce group in these years are such items as cutlery, hardward, sanitary ware, heating equipment of various sorts, firearms, safes and vaults, and other minor items.[1]

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[1]The Commerce iron and steel group includes groups nineteen and thirty-three of the Social Security Board Industrial Classification Code (Washington: Social Security Board, 1942). These groups include, among other things, guns, ammunition (except small arms), tanks, all of the products commonly thought of as output of the iron and steel industry, cutlery, hardware, files, saws, sanitary ware and plumbers' supplies, stoves, ranges, water heaters, hot-air furnaces, oil burners, power boilers, steam and hot water heating apparatus, metal stamping, auto stampings, metal doors, etc., fabricated structural metal products, bolts, nuts, washers, screw-machine products, firearms, safes and vaults.

It should be remembered that in the Commerce data wages and salaries are allotted to industrial groups on an establishment basis while the other distributive shares are assigned on a company basis. That is, interest, profits, and dividends are assigned to that activity in which the whole corporation is primarily engaged even though the corporation may produce the products of several industry groups.[1]

Kuznets' iron and steel group is less inclusive than that of Commerce and is closer to what is wanted here. He does not include cutlery, hardware, boilers, firearms, etc. But because it is a narrower group and also because he is dealing with an earlier period, the data have gaps. For 1926 to 1933 a close approximation to national income originating is possible with interest missing. For the period 1919 to 1938, the best that can be done is to use his wages and salaries for the iron and steel group.

The Importance of the Top Eight Firms as a Group

The first question to be investigated is whether the proportion of the "industry's" value added attributable to the top eight firms has changed.[2]

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[1]See p. 17 of the National Income Supplement to the Survey of Current Business, July, 1947.

[2]Putting this in percentage form is the equivalent of price deflation and removal of industry growth. Suppose prices for factor services in year one are K times those of year zero and that the quantity of input in year one is C times that of year zero. Capital letters apply to the industry and small letters to the eight firms. Then we have:

	$Year_0$	$Year_1$
Eight firms	pq	$kpcq$
Industry	PQ	$KPCQ$
Ratios	$\frac{pq}{PQ}$	$\frac{kpcq}{KPCQ}$

If factor prices are the same for the eight firms as for the industry and if they change in the same way, the change in the ratios will be $\frac{cq}{CQ}\cdot\frac{Q}{q} = \frac{c}{C}$. That is, the only thing that will show in the change from one year to the next is the change in c over and beyond the industry change, C.

From Table 14 it appears that the contribution of the top eight firms to value added by the whole industry has declined somewhat over the thirty year period from 1919 to 1948.

TABLE 14

VALUE ADDED BY THE EIGHT TOP STEEL FIRMS EXPRESSED AS A PERCENTAGE OF NATIONAL INCOME ORIGINATING IN IRON AND STEEL (COMMERCE AND KUZNETS) AND OF WAGES AND SALARIES IN IRON AND STEEL (KUZNETS), 1919-48

Commerce NI Originating				Kuznets "NI Originating"		Kuznets Wages and Salaries Originating*			
1948	33%	1938	40%	1933	86%	1938	79%	1928	88%
47	34	37	45	32	152	37	90	27	87
46	36	36	42	31	95	36	88	26	97
45	30	35	39	30	74	35	79	25	92
44	32	34	39	29	67	34	71	24	88
43	32	33	43	28	68	33	66	23	92
42	37	32	36	27	73	32	42	22	79
41	40	31	42	26	75	31	76	21	97
40	44	30	36			30	83	20	84
1939	43	1929	35			1929	93	1919	93
Average, 1939-48	36.1	Average, 1929-38	39.7			Average, 1929-38	76.7	Average, 1919-28	89.7

* The first year for which data for the National Steel Corporation are available is 1931. No correction was made for the fact that National was not in existence before 1930. For this reason, the decline should be slightly greater than that actually shown for the Kuznets definition of the industry. In the earlier years there are gaps in the data, but this was corrected for by extending the percentages back in chain fashion. This amounts to assuming that in the years for which there are no data for a company its percentage contribution moved as did the contributions of those firms for which there are data. In 1923-24, data are available for six firms; in 1922, four firms; in 1919-21, three firms, U. S. Steel, Bethlehem, and Armco.

The difference between the levels of the percentages for the Commerce data and for the Kuznets data on wages and salaries is a reflection of the difference in the coverage of the two definitions of the iron and steel industry and of the fact that wages and salaries are but one part of the income originating in the industry. But within each of the overlapping periods, 1919-38 and 1929-48, the percentage contributed by the eight top firms has declined.

This interpretation must be provisional, however. The coverage of Kuznets' wage and salary series is very close to what is desired, but even here the decline could possibly be explained by a change in the ratio of labor to other productive services as between the top eight firms and the other firms in the industry (or even changes in the same direction), leaving the ratio of value added to value added the same, but this is very unlikely in view of the direction the change would have to take. The coverage of the Commerce iron and steel definition is so broad that the whole of the decline in the top eight could be easily explained by a more rapid growth of oil burner firms and the like than of iron and steel firms in a narrower sense.

If the percentage of total industry value added attributable to each of the top eight firms is known, it is possible to very closely estimate what the index of concentration would be if the whole distribution of value added were known. A minimum value of $\underline{C}$ can be calculated on the assumption that the output of each firm beyond the eighth approaches zero. A maximum value of $\underline{C}$ can be calculated on the assumption that each of the firms beyond the eighth is equal in size to the eighth largest.[1] This will not give the maximum $\underline{C}$, of

[1]Perhaps a better assumption would be that the outputs of firms smaller than the top eight are equal. This would give lower maxima. In this case the difference would be very small. An incidental advantage of the assumption used is that it does not require the number of firms to be known.

course, if there is some firm with value added actually larger than that of the smallest firm in the group of eight. This is unlikely. The resulting coefficients of concentration are given in Table 15. In making these calculations, value added by each of the top eight firms was expressed as a percentage of value added by the whole industry, using the Commerce definition.

TABLE 15

CONCENTRATION IN VALUE ADDED BY FIRMS IN THE IRON AND STEEL INDUSTRY (COMMERCE DEFINITION) 1929-48

	Minimum	Maximum		Minimum	Maximum
1948	.03	.04	1938	.04	.05
47	.03	.04	37	.06	.07
46	.03	.04	36	.05	.06
45	.02	.03	35	.04	.05
44	.03	.03	34	.04	.05
43	.03	.03	33	.05	.06
42	.04	.05	32	.04	.05[a]
41	.04	.05	31	.07	.07
40	.05	.06	30	.05	.06
39	.05	.06	29	.05	.06
Average, 1939-48	.035		Average, 1929-38	.049	

[a]Youngstown Sheet and Tube had the smallest value added among the eight firms (-.3%). The remaining firms were assumed to have value added of 1.2%, equal to that of the seventh firm.

Concentration can also be calculated on the basis of Kuznets' definition of the iron and steel industry. The coefficients are, of course, higher than those resting on the Commerce definition. Unfortunately, the period for which they can be calculated is short. In the depression years of the 1930's, transient forces so distort the distribution of value added that the coefficient would not be meaningful. Because value added can be

negative for a firm (or an industry, for that matter), in 1932 values added by the eight top firms add up to more than one hundred per cent of Kuznet's value added by the iron and steel industry.[1] In addition, incomparabilities between the scope of the activities of the top eight firms and Kuznets' definition of the industry open the possibility of differential change from prosperity to depression.

TABLE 16

CONCENTRATION IN VALUE ADDED BY FIRMS IN THE IRON AND STEEL INDUSTRY (KUZNETS' DEFINITION) 1926-30

	Minimum	Maximum
1930	.23	.24
29	.18	.19
28	.19	.20
27	.24	.24
1926	.25	.26

Over the period 1929 to 1948, there was a slight decline in the concentration coefficient calculated on the basis of the Commerce definition of the iron and steel industry. A part of this decline is attributable to the small decline in the importance of the eight firms taken together, but the distribution of outputs within the eight firms also changed so as to lower the concentration coefficient.

To show the changes among the top eight firms, the period from 1925 to 1948 has been divided into five shorter periods. For each short period, value added by each of the eight firms has been expressed as a percentage of

[1] Recall that interest was not included in calculating this value added.

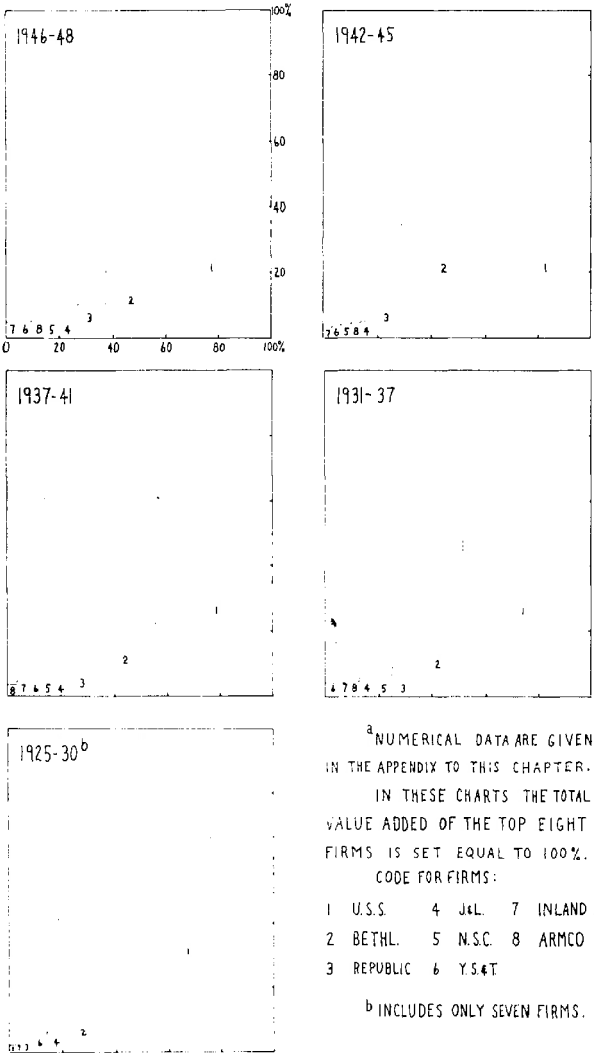
value added by all eight firms together. The results of this calculation are presented in graphic form in Figure 12. In these charts, each side of the large square equals one hundred per cent of the total value added by the eight top firms. Value added by each of the eight firms is shown from right to left in descending order of size, with each side of a firm's square equal to its percentage contribution to total value added by all eight firms.

The World War II years departed from previous patterns in that Bethlehem's value added was almost equal to U. S. Steel's value added, and in one year actually exceeded it. During 1946-48, however, previous long term changes were again in evidence. Leaving out of consideration the World War II years, the striking change has been the persistent decline in the position of U. S. Steel relative to the next seven firms from something over sixty per cent of the value added to a little more than forty per cent. The counterpart of this decline in U. S. Steel's position is to be seen in the rise of Bethlehem from sixteen per cent to twenty-one per cent of the total for the eight firms. Republic, which ranked fifth in 1925-30, rose to ten per cent by the late thirties and has since then retained that position. The position of the remaining large firms, considered as a group, has improved slightly as compared with the three largest firms. If it were possible to examine a longer period, an even greater decline in U. S. Steel's position would probably be shown, as is suggested by the examination of ingot capacity in Chapter II.

The results of the examination of ingot and pig iron capacity are confirmed by the material on value added. The same shift among the top firms is present, and the finding of no increase in concentration is duplicated, subject to certain qualifications. If these qualifications are met, there is indication of a slight decline in concentration from 1929 to 1948.

FIG. 12

DISTRIBUTION OF VALUE ADDED AMONG THE TOP EIGHT STEEL FIRMS DURING PERIODS FROM 1925 TO 1948[a]



[a] NUMERICAL DATA ARE GIVEN IN THE APPENDIX TO THIS CHAPTER. IN THESE CHARTS THE TOTAL VALUE ADDED OF THE TOP EIGHT FIRMS IS SET EQUAL TO 100%.

CODE FOR FIRMS:

1	U.S.S.	4	J&L.	7	INLAND
2	BETHL.	5	N.S.C.	8	ARMCO
3	REPUBLIC	6	Y.S.&T.		

[b] INCLUDES ONLY SEVEN FIRMS.

APPENDIX TO CHAPTER IV

TABLE 17

NATIONAL INCOME ORIGINATING IN THE EIGHT LARGEST STEEL FIRMS, 1919-48 ($000,000)[a]

	U.S.S.	Beth.	Rep.	J&L	NSC	YS&T	Inland	Armco
1948	1,274	656	329	206	181	161	154	161
47	1,124	515	280	175	139	124	127	137
46	823	454	186	121	107	88	84	109
45	837	702	193	116	99	83	76	92
44	1,087	1,032	225	136	96	85	85	168
43	1,066	1,092	228	137	99	89	82	72
42	1,017	853	244	120	96	97	81	71
41	872	501	214	102	84	94	84	69
40	606	297	133	71	64	62	59	42
39	448	202	100	50	52	46	47	36
38	296	134	54	30	38	31	31	23
37	574	216	107	66	64	50	47	45
36	404	144	91	51	51	44	42	39
35	261	96	58	32	44	28	30	30
34	198	77	37	21	31	18	19	20
33	134	61	26	16	23	7	11	14
32	69	32	9	7	17	-1	5	8
31	273	79	28	27	22	13	10	11
30	488	135	48	52		26	20	16
29	641	177	42	71		59	28	27
28	565	144	33	61		52	27	27
27	546	137	21	57		54	23	19
26	637	154	26	66		64	24	18
25	596	134	25	57		58	22	16
24	574	119	22	55		49		14
23	628	138	30	59		57		15
22	399	61	14					10
21	407	73						3
20	734	147						14
1919	644	167						11

[a]Abbreviations are as follows:

U.S.S. - U. S. Steel
Beth. - Bethlehem
Rep.-Republic
J&L - Jones and Laughlin
NSC - National Steel Corporation
Armco - American Rolling Mill
YS&T - Youngstown Sheet and Tube

TABLE 18

NATIONAL INCOME ORIGINATING AND WAGES AND SALARIES ORIGINATING IN THE IRON AND STEEL INDUSTRY, 1919-48 ($000,000)

	National Income Originating (Commerce)[a]	National Income Originating (Kuznets)[b]	Wages and Salaries Originating (Kuznets)
1948	8653		
47	7607		
46	5544		
45	7376		
44	9081		
43	9099		
42	6897		
41	5048		
40	3057		
39	2259		
38	1592		804
37	2586		1298
36	2061		980
35	1478		728
34	1085		591
33	682	341	445
32	410	85	350
31	1109	488	607
30	2212	1067	948
29	2978	1568	1126
28		1339	1028
27		1173	983
26		1322	1017
25			990
24			969
23			1047
22			722
21			606
20			1290
1919			1070

[a] P. 14, Survey of Current Business, July, 1949, and National Income Supplement to Survey of Current Business, July, 1947, p. 26.

[b] Includes wages and salaries, dividends, and corporate net saving. See Simon Kuznets, National Income and Its Composition, 1919-1938 (New York: National Bureau of Economic Research, 1941), pp. 584, 587, and 595.

TABLE 19

DISTRIBUTION OF VALUE ADDED AMONG THE TOP EIGHT STEEL FIRMS DURING PERIODS FROM 1925 TO 1948 ($000,000)

	USS	Beth.	Rep.	J&L	NSC	YS&T	Inland	Armco	Total
1946-48	3,227	1,624	795	501	427	372	365	407	7,718
42-45	4,006	3,679	1,089	510	389	355	325	404	10,756
37-41	2,795	1,351	609	320	302	282	269	214	6,142
31-37	1,912	704	356	220	253	158	164	167	3,934
25-30	3,472	881	195	364	...	314	144	124	5,494

Percentage Distribution

	USS	Beth.	Rep.	J&L	NSC	YS&T	Inland	Armco	Total
1946-48	41.8%	21.0%	10.3%	6.5%	5.5%	4.8%	4.7%	5.3%	99.9%
42-45	37.2	34.2	10.1	4.7	3.6	3.3	3.0	3.8	99.9
37-41	45.4	22.0	9.9	5.2	4.9	4.6	4.4	3.5	99.9
31-37	48.6	17.9	9.0	5.6	6.4	4.0	4.2	4.3	100.0
25-30	63.2	16.0	3.5	6.6	...	5.7	2.6	2.2	99.8

CHAPTER V

PRICE BEHAVIOR OF STEEL PRODUCTS

In this and succeeding chapters, aspects of the steel market other than concentration will be examined to determine whether or not the steel industry has become more or less competitive over the last half century. This will permit a check to be made, rough though it is, on the significance of measures of concentration as indicators of price behavior. The first problem to be discussed is price rigidity as related to the degree of monopoly. The subsequent examination of the price behavior of certain products of the steel industry will not be a history of their markets. Instead, the attempt will be made to draw implications for long run changes in the degree of competition in the industry from an examination of observable aspects of price behavior.

The Relation of Price Rigidity to Monopoly

If price rigidity is directly associated with the degree of monopoly over the whole range of monopoly power, it is clearly easier to reason from price rigidity to monopoly power than if price rigidity increased with monopoly power up to a point and then decreased as monopoly power increased. Should it be true, for example, that a closely knit oligopoly will have less rigid prices than a weaker group, then an observed increase in price rigidity could mean either a change from fairly competitive conditions to weak oligopoly or a weakening in the strength of an initially strong oligopoly. It would be necessary to identify precisely the initial situation as well as to discover the change in rigidity that had taken place. But if the initial situation could be identified with confidence, there would be little reason

to take the indirect route of price rigidity to diagnose the second situation. Its characteristics could just as well be determined directly, as were those of its predecessor. Actually, this procedure would be extremely difficult. Hence, a monotonic relationship between price rigidity and the degree of monopoly is important for any results expected from an examination of price rigidity. This is all the more true because the examination of price rigidity does not take account of some factors (one of importance is the behavior of direct costs) which obscure results. In dealing with the relationship between rigidity and the degree of monopoly, the common arguments will be summarized, although they are inconclusive, for a satisfactory explanation of this problem seems to rest either on the quantitative importance of some of the considerations commonly adduced or upon considerations that have not as yet been brought forward.

In the oligopoly situation, one of the important factors making for price rigidity (especially as measured by frequency of price change) is the fear that a disturbance of the price structure at certain times may result in its disintegration. There is undoubtedly great difficulty in working out a modus vivendi with respect to price structure that is satisfactory to all the firms involved. A new set of prices is not lightly to be proposed, for before assent to it can be secured, and it must be a well-nigh universal assent so far as the more important firms are concerned, the industry may pass through a period of warfare.

The second factor that makes for some rigidity, as compared with competitive adaptation to the same changes in demand or cost conditions is the consideration of long run effects. In the competitive situation, pricing in the short run is unaffected by such factors except in so far as present cost elements are linked with expected developments, thus affecting current

supply. Where, however, the determination of price is not independent of the individual firm (from the point of view of the firm), long run factors, especially those affecting the demand curve, will be taken account of. One of the most frequently mentioned of long run factors is the threat of government action or, what comes to much the same thing, the maintenance of good "public relations." This may result in lower peak prices during the business cycle, although it does not seem especially suited to explain a failure to lower prices during depression, unless one is prepared to argue that the raising of prices during recovery from a depression low will be looked upon askance by the Department of Justice. Along the same line, if it is anticipated that higher prices will be taken as an incentive to workers to demand higher wages, temporarily higher prices may be foregone, especially in view of the downward inflexibility of some wage rates. There seems to be little doubt but that both these influences were at work in the United States during the rise of prices as indicated by price indexes after the elimination of price control in 1946.

Two other long run factors often cited as reasons for inflexibility are the threat of new entrants and the possible development of substitutes. These, however, seem better calculated to explain a lower price level rather than less frequent price changes or changes of smaller amplitude. If the profitability of business opportunities is commonly overestimated by outsiders in boom periods, though, the long run profit position of those already in the industry will be better if short run profits at this time are not maximized. A similar argument may be made for development of substitutes if there are many users of the product who would mistakenly diagnose what is in fact a short run price increase as a permanent change and would thereby be led to make arrangements to use a substitute product. If these arrangements

involve enough capital outlay, the switch may be relatively permanent even though the price of the oligopoly's product is shortly reduced. In addition to the possible cost of failure to agree on a new price and the adverse long run effects, there are other costs directly involved in price changes which will have some effect such as price lists, new catalogues, and the like.

Applying particularly to declines in prices is the fear of spoiling the market. Presumably a low price now lessens the chance of getting a good price later. In the case of durables, there may be substantial disadvantages to lowering price now, because increased sales now at a lower price may to some extent actually be borrowed from future sales. Secondly, it is alleged that a decrease in price may create the expectation of a further fall in price, thus causing a temporary decline in demand. That this sequence operates once a price is falling is scarcely to be doubted, but those who stress this point as an explanation of failure to lower the price of product A when other prices are falling have the task of explaining why the demand curve for product A does not move to the left as a result of the prospective buyer waiting for a decline on the reasoning that if the prices of the other products are declining, the price of A will also decline.[1]

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[1]Among the many discussions of the reasons for rigidity, two are commended to the reader: G. J. Stigler, "The Kinky Oligopoly Demand Curve and Rigid Prices," Journal of Political Economy, LV (October, 1945) 437; the second is A. C. Neal, Industrial Concentration and Price Inflexibility (Washington, D. C.: American Council on Public Affairs, 1942), chap. IV, "User Cost and Depression Price Policy." Neal discusses future considerations under the label, user cost, which he defines as the decline in the value of the firm's facilities during the "week" less the cost of optimum maintenance if facilities were unused. Presumably the "week" is that period during which plans will not be changed. Since the value of facilities at the end of the week will depend on the subsequent revenue and cost history of the firm, any repercussions of this week's actions on the future will automatically be given consideration by this device.

Several factors not discussed above are said by Neal to influence price rigidity. The principal of these is probably high overhead costs which

Turning to monopoly, our starting point can be the proposition that, under certain conditions, a given proportionate change in the demand and cost curves, leaving elasticities unchanged, will lead to equal proportionate changes in both the monopoly price and the competitive price--and equally frequent changes so long as the cost of initiating a change is neglected for monopoly.[1] Even on the basis of short run considerations only, this proposition is subject to modification depending on the behavior of price elasticity when demand changes. If price elasticity becomes greater when demand falls, the relative amplitude of price change for monopoly will be less than for competition and vice versa.

All of the factors making for rigidity of prices in the oligopoly situation have application to monopoly with a few exceptions. The monopolist does not have any difficulty in coming to agreement with himself as do the oligopolists in agreeing among themselves. His price is never threatened by bolters or secret price cuts. Fear of government action may possibly be less because of the emphasis our law puts upon conspiracy.[2] In this connection it

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are supposed to produce an aversion to price cutting and hence lead to more rigidity. As Neal observes, however, firms in an industry with a small margin between price and average variable cost would probably be just as concerned over a halving of this margin as would the firms in an industry with a large margin. But the firms in the former industry are supposed to be able to better ease their plight by securing price reductions from suppliers and labor. That is, a smaller percentage reduction will do them more good. (See Neal, pp. 74-5). This seems a dubious proposition.

Neal emphasizes that the importance of future adverse reactions from other firms will have greater effect on present policy the smaller the number of firms and will, therefore, make for greater rigidity for most of the influences discussed.

[1]Sufficient conditions, similar to those given by T. de Scitovszky in "Prices Under Monopoly and Competition," Journal of Political Economy, XLIX (October, 1941), 663-86, are iso-elastic demand and cost (supply) curves, which is to say, linear demand and marginal cost (supply) curves in the logarithmic plane with dimensions price and quantity. His proposition that price change will be equal (proportionately) for monopoly and competition for a change in demand leaving price elasticity unchanged if the competitive supply is a horizontal displacement of the monopolist's marginal cost curve is wrong, for it is easy to draw non-linear horizontally displaced curves that will not give this result.

[2]For example, see Stigler, op. cit., p. 443.

should be noted that fear of government action can hardly be urged as a very important element in the explanation of the extreme rigidity of some monopoly prices, because it proves too much. It is hard to think of a policy better calculated to draw the attention of government, and of the "public," than one of constant price in the face of almost every kind of change, unless it be a policy of steadily increasing price. If obscurity is desired, it would be better attained by a price that fluctuates with the general price level combined with a long run decline relative to the general price level if technological advance is rapid enough to permit it, thus permitting the monopolist to point out, in the event of trouble, either the increased competition he is enjoying or the benefits he is giving the consumers of his product.

It is sometimes suggested that the rigidity of monopoly prices may be explained in part by the fact that monopolists are lazy and are indifferent to the amount of money they make, provided the monopoly profit is above some minimum amount. Indeed, it seems to have become de rigueur for economists to quote J. R. Hicks on the benefits of the quiet life. This position may possess a limited validity, for some increases in profit are too small to warrant the cost of obtaining them, but probably one should restate the phrase: he who wants a quiet life should not be a monopolist, or a business man.

As compared with monopoly, an imperfectly competitive market may show greater rigidity, as measured by amplitude of price change, than the monopolistic market because the operation of what has been called the competitive illusion may produce larger errors in the price estimate. That is, the estimates of a situation by the different competitors are either not independent of each other or fail to take adequate account of what the other producers will do. The competitive illusion would have to be fairly strong, however,

for if the estimating ability of any competitor is equal to that of the monopolist and if the estimates of the competitors are not too highly correlated, or are negatively correlated, the errors made by the competitive market so far as demand estimates are concerned will show a smaller dispersion than those of the monopolistic market, for in the former case the dispersion of means of samples is involved whereas the monopolist does not have the opportunity to offset errors in estimating a given situation.

Unfortunately, the factors making for rigidity that have been discussed do not give any clear indication of whether rigidity will increase as effective monopoly is more closely approached. It is clear that they will both show less flexibility than the competitive market. If these explanations do not resolve the issue, perhaps empirical data will shed light on it.

This question of monopoly and oligopoly prices was considered by Stigler in both its theoretical and empirical aspects.[1] His findings, covering the period 1929 to 1937, indicate a decrease in price flexibility as the number of firms decreases, with a rank correlation of + .41 between number of firms and number of price changes. The number of firms in the oligopoly industries studied ranged from two to twelve. The rank correlation between the coefficient of variation of prices over this period and the number of firms was + .31. It seems a fair presumption that if it had been possible to take account of the varying cost structures and cost behavior in these industries, the relationship would have been closer.

Stigler's evidence on the flexibility of monopoly prices in comparison with oligopoly prices is more conclusive. He notes that aluminum, nickel,

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[1] Ibid., esp. pp. 442ff.

magnesium, IBM rentals, and incandescent lamp prices show extreme rigidity, whether measured by frequency of change or amplitude. The known successful periods of collusion in the industries he studied also are periods of highly rigid prices. These include rayon, copper, pineapple, typewriters, and the Midwest gasoline pool of the middle thirties. This is highly relevant for the present problem, because the hypothesis it is desired to work with is that an anti-competitive development will manifest itself in increased price rigidity.

The connection between A. C. Neal's work on concentration and price flexibility and the hypothesis under discussion should be made clear.[1] He finds a weak relationship between concentration and price change from 1929-33, but decides this is spurious because (a) there is a weak relationship between concentration and direct cost change, and (b) direct cost change explains most of the original variability in the 1933 price indexes (with 1929 as a base).

If deviations of expected prices[2] from the actual price indexes are correlated with concentration, he finds slight relationships in the expected direction with $r = -.25$ for 1929-31 price changes and $r = -.19$ for 1929-33. He also finds that the partial correlation coefficient between these deviations and concentration, with the influence of the ratio of overhead plus profits to price held constant, is -.31 for 1929-31 and the same for

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[1] A. C. Neal, op. cit., esp. Chap. VI, "Flexibility of Prices Relative to Costs--Results."

[2] Expected price would be attained if the 1929 price declined by the absolute decline in direct cost per unit of output. His procedure assumes that the absolute margin per unit between price and direct cost remains the same. Concentration is measured by the ratio of the sales of the four largest firms to industry sales.

1929-33, indicating that the margin between direct cost and price slightly obscures the relationship between concentration and price flexibility relative to direct cost changes.

It should not be concluded on the basis of Neal's findings that there is little or no relation between price rigidity and the degree of monopoly. Suppose, for example, that the conditions making for rigidity were accurately known and that these were recognized as departures from competition toward monopoly. If high concentration was necessary but not sufficient for the appearance of rigidity conditions, we should expect distributions between concentration and price flexibility of the sort obtained by Neal, the essential feature being an increase in the dispersion of price changes over a cycle the higher the concentration, either before or after correction for differential direct cost behavior. Visual examination indicates that this feature is present in his charts. Of course, to the extent that this is true, the connection between concentration and monopoly power via price rigidity becomes obscured. Increased concentration would not necessarily be associated with greater price rigidity, but greater price rigidity might still be taken as evidence of an increase in monopoly power.

It is concluded here that Neal's work is not inconsistent with the hypothesis that price rigidity and monopoly power will be associated. The proposition will be applied in this study to a single industry. The propriety of this application is not necessarily upset by a cross-section study that fails to discover a relationship between rigidity and monopoly power or concentration for different industries. The relationship may hold for any industry taken separately over time and at the same time the relation between rigidity and monopoly may vary so much among industries, with an even greater variation between rigidity and a summary measure of monopoly such as

concentration, that a cross-section empirical study may be unsuccessful in discovering any relationship. In a cross-section empirical study, comparisons of price amplitudes of different products over the same cycle require that the differences in rigidity because of varying degrees of monopoly be substantial in order to show through the varying cost structures, short run supply curves, and changes in demand or that these characteristics be similar for the different industries. In principle, the same problem is involved in the study of the same industry over time. But it should be emphasized that differing cost structures and short run supply curves over time would seem to be much less troublesome than for a comparison of different industries over one cycle.

When the hypothesis of a direct relationship between rigidity and monopoly power is applied to a single industry over time, it is possible that a change in the fluctuations of the industry's prices will be a reflection of change in the fluctuation of the general price level. For this reason, fluctuations in the Bureau of Labor Statistics wholesale price index will be used as a standard of reference in some of the work that follows. Similarly, if demand for the industry's products fluctuates less now than formerly, the amplitude of price change could show a decline with no real change in price determining forces connected with the issue of monopoly. With respect to pig iron production, Burns' and Mitchell's findings are consistent with the hypothesis that there has been no secular change in the cyclical characteristics of this series.[1] This is not equivalent to the statement that the amplitude or duration of the pig iron production cycle

[1]A. F. Burns and W. C. Mitchell, Measuring Business Cycles (New York: National Bureau of Economic Research, 1946), pp. 384-93.

has been nearly constant over the period they studied, which was from 1879 to 1933. There has been variation in the cyclical characteristics of the pig iron production cycle, but this variation has not been systematically related to time so far as can be concluded, given the amount of variation that has been present in shorter portions of the whole period.

Findings on Price Rigidity

Examination of the proper price data should give indication of the direction of development of monopoly power in the iron and steel industry, making use of the hypothesis discussed above, namely, that a higher degree of monopoly power will be accompanied by more rigid prices. To secure the truly appropriate price data would necessitate a mammoth statistical project involving detailed examination of either steel company or customer records. Such a project has never been undertaken for lack of investigatory facilities or reluctance to disclose data. In this case, it is necessary for the academic investigator to turn to regularly published price data which may be found, among other places, in the trade publication Iron Age. Although the Iron Age price series are deficient for many of the purposes for which the economist would like to use them, in the present case the deficiencies do not prevent the development of data which can be inserted into the main hypothesis of this section.

Price Flexibility as Measured by Amplitude

Two measures of price flexibility have been calculated, the coefficient of variation and relative frequency of price change. The period covered ranges from 1889 or 1900, depending on the product, to 1948. The unit of experience for which each of these measures is calculated is the business cycle.

Business cycles are marked off from trough to trough, using dates as developed by the National Bureau of Economic Research. These cycles, reproduced in the table below, have been numbered and subsequently will be referred to by number. The trough date of the first cycle is actually April, 1888. The ninth cycle is arbitrarily cut off at the entry of the United States into World War I. The fifteenth cycle is not a cycle at all but represents merely experience approximately after the price control of World War II.

TABLE 20

TROUGH DATES OF BUSINESS CYCLES

Number of Cycle	Trough Dates of Business Cycles		Incomplete Cycle
1.	1-1889 to	5-1891	*
2.	2-91	6-94	
3.	6-94	6-97	
4.	6-97	12-00	
5.	12-00	8-04	
6.	8-04	6-08	
7.	6-08	1-12	
8.	1-12	12-14	
9.	12-14	3-17	*
10.	4-19	9-21	
11.	9-21	7-24	
12.	7-24	12-27	
13.	12-27	3-33	
14.	3-33	5-38	
15.	7-46	12-48	*

The products whose prices are studied include rails, galvanized sheets (at Pittsburgh), cast iron pipe (at New York), structural shapes (at Pittsburgh), merchant bars (at Pittsburgh), plates (at Pittsburgh), and pig iron (valley furnaces). The prices used are base prices and do not include any extras or transportation. The coefficient of variation is also calculated for the

Bureau of Labor Statistics wholesale price index, with 1889 as extended back from 1890 by Warren and Pearson.[1]

The coefficients of variation of average monthly prices of the commodities are given in Table 21 and are shown graphically in Figure 13.

A straight line trend has been fitted to each of these "time" series by the least squares criterion, using cycle numbers as the independent variable. The solid trend line on the graph covers the period from 1889 on (1891 for rails), and the dashed line covers the period from the fifth cycle on. The fifth cycle began a few months before the formation of U. S. Steel. The signs of the regression coefficients of the trend lines are as follows:

	1889-1948	1900-1948
BLS wholesale index	+	*
Rails	-	+
Galvanized sheets	*	-
Cast iron pipe	*	+
Merchant bars	+	-
Structural shapes	-	-
Plates	-	-
Pig iron	-	-

*Not calculated

In no case does the slope of the trend line differ significantly from zero, using a five per cent level of significance. t for the BLS trend line comes closest to the five per cent value. When the significance of the difference between the slopes of the BLS index trend and each of the product trend lines is tested, it is also true that none of these differences departs significantly from zero, again using five per cent as the level of significance. The difference for rails comes closest to the five per cent value of t, and this is

[1] BLS Bulletin No. 572, p. 114.

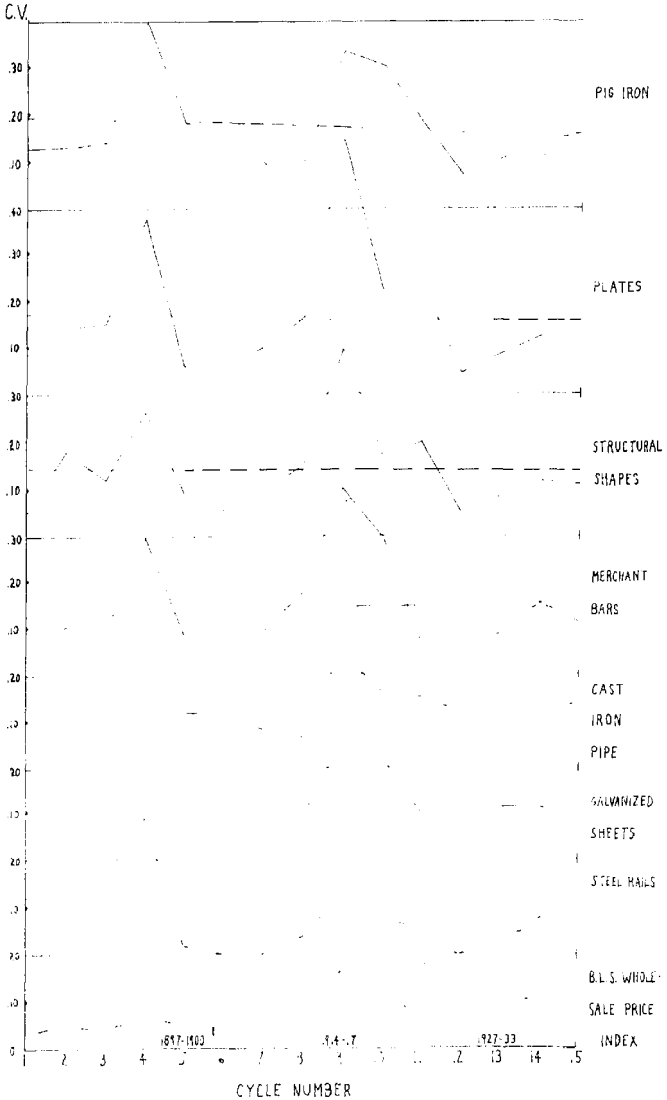
TABLE 21

COEFFICIENTS OF VARIATION FOR IRON AND STEEL PRODUCTS
MONTHLY PRICES DURING BUSINESS CYCLES AFTER 1889

Cycle	BLS wholesale price index	Steel rails	Galvanized sheets	Cast iron pipe	Merchant bars	Structural shapes	Plates	Pig iron
1	.02	...	...	...	.04	.05	.08	.13
2	.06	.12	...	...	.10	.18	.14	.13
3	.03	.16	...	...	.08	.12	.15	.14
4	.08	.29	...	...	.30	.26	.37	.39
5	.04	.02	.14	.12	.08	.09	.06	.18
6	.04	0	.05	.11	.06	.05	.05	.17
7	.05	0	.07	.08	.09	.09	.10	.09
8	.02	.03	.08	.06	.17	.15	.16	.10
9	.16	.12	.24	.24	.39	.39	.54	.33
10	.19	.09	.22	.16	.29	.17	.22	.30
11	.04	.04	.10	.15	.07	.20	.23	.18
12	.03	0	.06	.12	.05	.05	.04	.07
13	.16	.02	.11	.09	.08	.08	.08	.10
14	.08	.07	.11	.10	.15	.12	.12	.14
15	.09	.12	.08	.14	.11	.11	.11	.16
Average C.V.	.07	.08	.11	.13	.14	.14	.16	.18

FIG. 13

COEFFICIENTS OF VARIATION FOR PRICES OF IRON AND STEEL PRODUCTS DURING BUSINESS CYCLES AFTER 1889



because the rail pool was dissolved in 1897, followed by a period of large fluctuations in the price of rails, with considerable stability thereafter. With respect to amplitude of price fluctuation, the rail situation during the early years after the formation of the Corporation could scarcely be expected to deteriorate, unless to a negative amplitude. There was room only for improvement.

There is a very rough correspondence between the movements of the coefficients of variation of iron and steel products and those of the BLS wholesale price index, although "special" factors obscure it. The years immediately preceding the formation of the Corporation were years of strong demand for iron and steel products and produced a large upward movement in their prices. In the years 1915 to 1917, the iron and steel industry was favored by heavy war demands. In the 1927 to 1933 cycle, the extraordinary fall in agricultural prices helps to explain the lack of correspondence in movement between the series for wholesale prices and each of the others, although the direction of movement for each product is the same as in the case of the series for the BLS index.

Graphic examination, for each product, of its coefficients of variation expressed as a function of the coefficients of variation for the BLS index and time carries faint suggestions of (a) a decrease in the amount of rise in the coefficient of variation (of the iron and steel product) associated with a given change in the coefficient of variation of the BLS index, and (b) a lowering of the above relationship through time. The reduction in the amount of original variation is so small, however, that no significance should be ascribed to these suggestions. The analysis is not reproduced here.

To conclude, these data on amplitude of price change, as measured by the coefficient of variation, do not appear to support the hypothesis that the flexibility of base prices has decreased over this period.

Price Flexibility as Measured by Frequency of Price Change

The results of an examination of the relative frequency of price change (the number of actual changes in average monthly price during the cycle divided by the total number of possible changes) are not quite so neutral as those for amplitude. The relevant data are given in Table 22 and Figure 14.

The slope of the straight line trend is negative for every product. The slopes of two trend lines differ significantly from zero. For cast iron pipe, $\underline{t}$ exceeds the five per cent value but not the two per cent value. For pig iron, $\underline{t}$ exceeds the one per cent level. $\underline{t}$ for the other products does not exceed the five per cent level. The values for the 1933-38 cycle are probably lower than they would otherwise have been because of operations under the NRA which produced increased price rigidity. Recall that "official" prices are used here. On the basis of these data, one is inclined to entertain the possibility that an actual decline in the relative frequency of price change has taken place. Although taken separately only two of the series show a significant decline, the fact that all of the slopes are negative carries additional weight.

The results so far have been derived from base prices as reported in Iron Age. Some writers would probably maintain that these results are not significant because reported base prices do not reflect the prices at which transactions are actually made because of extras, phantom freight or freight absorption, and outright concessions from published base prices plus "correct" extras and freight. Of course, those who maintain that a high degree of collusion existed in the operation of the steel industry's basing point system are implicitly asserting that published base prices are a faithful reflection of actual prices paid by buyers, aside from variation in the distribution of

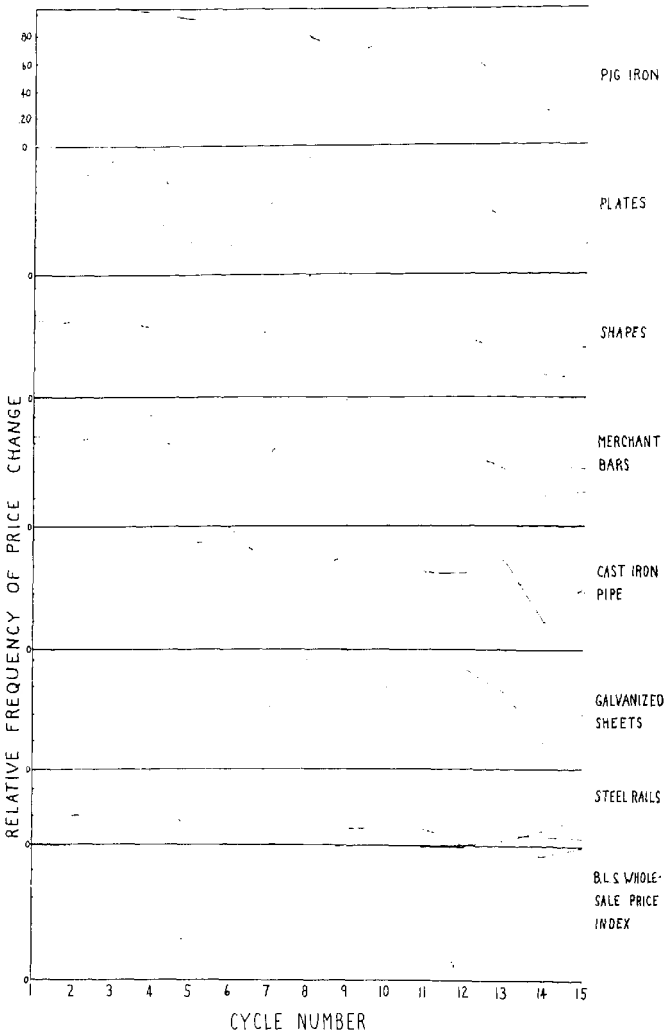
TABLE 22

RELATIVE FREQUENCY OF PRICE CHANGE IN IRON AND STEEL PRODUCTS DURING BUSINESS CYCLES AFTER 1889

Cycle	Rails	Galvanized sheets	Cast iron pipe	Merchant bars	Structural shapes	Plates	Pig iron
1	...	...	...	.50	.43	.64	.96
2	.21	...	...	.59	.57	.68	1.0
3	.22	...	...	.72	.61	.83	1.0
4	.55	...	...	.81	.50	.93	.98
5	.05	.73	.74	.34	.27	.23	.93
6	0	.46	.89	.24	.17	.20	.96
7	0	.44	.60	.51	.51	.51	.98
8	.03	.80	.51	.86	.89	.86	.80
9	.11	.89	.70	.93	.78	.85	.63
10	.14	.59	.79	.69	.55	.72	.79
11	.12	.71	.56	.50	.56	.71	1.0
12	0	.73	.56	.54	.44	.66	.68
13	.03	.57	.65	.41	.30	.33	.40
14	.10	.18	.19	.21	.15	.21	.23
15	.21	.17	.45	.24	.21	.21	.41

FIG. 14

RELATIVE FREQUENCY OF MONTHLY PRICE CHANGES OF IRON AND STEEL PRODUCTS DURING BUSINESS CYCLES AFTER 1889



product specifications and in the geographical distribution of the buyers, or if they maintain that observance of the basing point system has been poor, a still more complex mechanism for joint action than the basing point system would seem to be implied. The issue of how closely base prices have been observed will be discussed in detail at a later point, but one piece of evidence has relevance to the immediate problem. In a BLS study made in 1943, the following statement is made:

> Prior to 1930 when base prices represented almost the entire price of steel, they fluctuated more than during the past several years, and they indicated the level and trend of prices fairly well. Today when extras are an important part of the price of steel, sometimes more important than the base price itself, base prices have lost much of their sensitivity as measures of steel prices.[1]

The interpretation of this statement in the present connection is not self-evident. If base prices have declined in flexibility absolutely, the implication for the flexibility of actual prices will depend on the extent to which the basing point system is observed in the various phases of the cycle and on the flexibility of the structure of prices of extras. That is, the fluctuation of actual prices may be thought of as equal to some measure of the fluctuation in quoted prices times a measure of the variation in adherence to quoted prices. If quoted and actual prices move up and down together, the variation in adherence to quoted prices would be equal to one. The degree of observance would be constant and it might be high or low, but would probably be high. If actual prices fluctuate more than quoted prices, the degree of observance changes over the cycle. It seems doubtful that enough time has elapsed to be at all sure that a decrease in absolute flexibility of base prices has developed after, say, World War I. If the statement is interpreted

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[1] Iron Age, April 25, 1946, p. 126. The BLS study, "Consumers' Prices of Steel Products," is apparently almost fully reproduced here.

to mean that the flexibility of base prices has declined relative to that of actual prices (i.e., variation in adherence to basing point prices over the cycle has increased), an unchanged absolute flexibility in base price would imply an increase in the flexibility of actual price, provided a decrease in the flexibility of extras does not offset. On this interpretation, a decrease in flexibility of base price could be consistent with an increase in flexibility of actual price if variation in observance of base prices has increased sufficiently.

The implications for flexibility of actual price depend on the extent to which base prices are observed when there is unused capacity. Hence, an examination of the operation of the basing point system, under which steel products have been sold from at least as early as 1901 to 1948, is necessary.

The Basing Point System

To say that an industry prices its products by use of a basing point system is not very informative. To some, use of a basing point system represents competition because it insures uniformity of price at each point of delivery. Some see it as an instrument of oppression for both small firms in the industry and buyers. For some, it is a satisfactory system provided it doesn't work too well. Steel industry spokesmen have at various times maintained that it is nothing but a convenient system of price quotation.

Assertions like these are bound to be inconclusive because the phrase, basing point system, is a very general one and constitutes an incomplete specification of a price-making situation. The proper characterization of a particular basing point system will depend on specific conditions accompanying its operation. These conceivably could range from a highly competitive situation, in the strict sense, to a situation representing a high degree

of collusion. In the first case there would be many producers at each point of production, each point of production a base, and the announcement of a base price would be of very brief effectiveness and would be equivalent to an offer to sell in a competitive market. There would be no cross shipments and the price difference between any two points could be no greater than the cost of transportation. It is unlikely that this situation would be termed a basing point system, but there seems to be no formal reason why it cannot be so labeled. In the second case, producers would be separated. Other producers' base prices would always be observed when shipping into their territories, and there would be collusion in the setting of the base prices. The cross hauling would be an expression, not of the perfection of collusion, but rather of its imperfection, for it would always be possible to charge the same delivered prices, ship from the nearest point of production, and divide up the increase in profit which would be approximately equal to the savings in freight costs.

In this section certain aspects of the steel industry's basing point system will be examined which give some indication of how effective it has been as an instrument of cooperative action.[1]

If basing point prices were always observed, with never any secret price cuts, the conclusion would be inescapable that a high degree of cooperative action is present. The absence of collusion in the setting of base prices does not erase the stigma of cooperative action, because the inducements to reduce price would be stronger if price cuts were not immediately publicized. The basing point system does provide a built-in mechanism by

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[1]For a general analysis of the basing point system, see The Basing Point System by Fritz Machlup (Philadelphia: Blakiston, 1949). In this book are references to earlier discussions of the system.

which the price cuts of a firm can be met in "its territory" by all the other firms selling there provided the system is observed and the price cuts are announced. Consequently, secret discounts are of importance, for if they occurred frequently enough when firms have available unused capacity, the basing point system would be but a hollow shell, a mere "means of price quotation" (a method not adhered to in this case, incidentally), or base prices would move up and down in reflection of non-collusive struggles for business. In everyday usage the market would be called competitive, although the geographical structure of production might prevent the elimination of freight absorption and hence of discrimination in mill nets and for this reason could not be termed strictly competitive according to the usage of economics. The importance of the frequency of secret discounts in mitigating the collusive nature of basing point pricing is indirectly indicated by a statement that Mr. Fairless of U. S. Steel made before the TNEC in 1940. He said,

> . . . we will concede that if base prices as announced were followed in every transaction, and that the nearest basing point to the consumer governed, and that the rail freight was added from that point, and the delivered price arrived at in that manner, there wouldn't be any competition in the steel industry. It would be a one-price industry, pure and simple.[1]

Because of the very nature of the act, information on secret price cuts is difficult to acquire. Nevertheless, several summary verdicts on this question have been expressed. They deserve to be cited because they probably represent prevailing opinion (outside the industry) and also because they give the impression that secret price cuts were fewer than they seem actually to have been on further examination of pertinent information.

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[1] TNEC Monograph No. 1, p. 281. Apparently the statement was made in an unguarded moment, for a later letter to the Committee repudiated it.

According to the Federal Trade Commission, the only time Pittsburgh plus broke down was when secret price cutting took place. Even in 1919, a poor year, Pittsburgh plus continued on sheets, tin plate, wire and wire products, plates, shapes, and bars. In 1921, a very bad year, the system prevailed on sheets, tin plate, wire, and wire products.[1]

A more comprehensive statement was made by Frank Fetter. According to him, the rule was continued adherence to the system after the formation of U. S. Steel, except for occasional periods as in 1908, 1909, 1911, and 1921.[2] Later he states, "Never was a decade [1911-20] so completely lacking in periods of 'open markets,' never was the system of Pittsburgh basing-point prices all over the country maintained so near to perfection. There were merely slight ripples to disturb the calm."[3]

Melvin de Chazeau notes the 1909, 1911, and 1921 breaks plus also the secret price concessions of the early thirties. He also comments on the lack of disturbance to the system from early 1912 to 1921.[4]

Machlup also believes that the basing point system is not very often broken. He of course recognizes "some defection" from the system during the depression of the thirties.[5] He is of the opinion that secret cuts, rather than competitive base price reductions, lead to lower prices in a basing point cartel during a general price decline. "Occasional breaches of the basing-point rules have occurred in all basing-point industries." A few sentences

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[1]Federal Trade Commission Decisions, Vol. 8, p. 45.

[2]F. Fetter, The Masquerade of Monopoly, p. 128.

[3]Ibid., p. 136.

[4]C. R. Daugherty, M. G. de Chazeau, and S. S. Stratton, The Economics of the Iron and Steel Industry (New York: McGraw-Hill, 1937) pp. 539-41.

[5]Machlup, op. cit., p. 68.

later there is a stronger statement:

> This [the possibility of gain from secret cuts] explains why major breaches of the pricing rules have occurred repeatedly over the years in almost all basing-point industries.[1]

But a few pages later there is considerable qualification. He writes,

> It is fairly well established, however, that observance of the basing-point rules in steel, cement, and other industries was almost perfect in times when business was reasonably good. When business was slow, observance was remarkably high with respect to the majority of orders, although customers having larger orders to place were able to obtain secret concessions. This was true at least for the steel industry. Only very rarely--indeed, only a few times during several decades--was disaffection so general that the market became 'demoralized.' These outbreaks of unrestrained price competition were so exceptional that they were carefully recorded in the history of the industry concerned. . . . The contention that price competition normally exists and effectively operates under the basing-point system by way of nonobservance of its rules can surely not be supported.[2]

In this same paragraph, Machlup comments on the significance of secret price cuts. He argues that secret deviations, even if present, will favor buyers who will use their competitive advantage to perpetuate or increase an already high concentration of control in their lines of production. The natural questions to this argument are whether it is always the case that those who receive concessions are in a line of production in which concentration of control is already high and whether price concessions are given only to the larger firms. The latter question is answered later when he says,

> While the concessions may first be confined to the very largest orders, there is a tendency for such competition to spread and to affect an increasing amount of business. Thus, discrimination through price cutting may unfreeze a price structure that has become frozen by systematic discrimination through the fixing of geographic price differentials.[3]

Indeed, there seems to be no good reason why the issue of discrimination

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[1] Machlup, op. cit., p. 114.

[2] Machlup, op. cit., pp. 116-117.

[3] Machlup, op. cit., p. 181.

must be considered inseparable from the problem of adjusting the level of steel prices to changed market conditions. If the level of steel prices is more flexible by means of secret price cuts, that must be entered on the credit side even though discrimination remains.

While these authorities are unanimous in holding that the basing point system has operated according to plan a good deal of the time with "occasional" interruptions, the evidence on which this contention is based is incontestably sketchy. Still less is there any indication whether secret cuts played an increasing or decreasing role over the forty-seven years the basing point system was in operation under the aegis of the U. S. Steel Corporation. An adequate answer to this question cannot be developed here, but a survey of some of the available evidence, paying attention to the whole period, may give indication of the direction in which an adequate answer would point. In the remainder of this chapter, some of the quantitative studies of observance will be examined.

There have been several studies which attempt to derive quantitative estimates of the extent of observance of the basing point system. It is possible to make some comparisons between two periods, the first from approximately 1902 to the early twenties, and the second from 1939 to 1942.

The most comprehensive study, for the period it undertook to cover, was made by the Bureau of Labor Statistics in 1943 for the use of OPA and WPB, and covers selected calendar quarters from 1939 to 1942.[1] The first comparison is between this study and one made by the Department of Justice for the TNEC

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[1] This study, entitled "Consumers' Prices of Steel Products," was written by Willard Fazar and Fay Bean under the supervision of Kenneth Hunter. It was reported in Iron Age, April 25, 1946, pp. 118 ff., and it is this version that has been used. Usable data were received from 629 steel consumers. No subsidiaries of steel companies were included. That is, the price data were secured from the customers of steel companies.

covering one month, February, 1939.[1] This provides no information on changes in observance over time, but a comparison of February, 1939, with the second quarter of 1939 is useful as a check on the reliability of the BLS study.

In the BLS study, with each of the commodities treated separately,[2] there is a frequency distribution of delivered invoice price of steel purchased by consumers expressed as a percentage of the April, 1942, published delivered price.[3] Thus the distribution conveys the extent of adherence to basing point pricing.

The Department of Justice gives essentially the same information, except that instead of comparing actual delivered price with a calculated delivered price, a calculated base price (equals actual delivered price minus published extras and freight from basing point) is compared with the published base price.

The percentage of cases in which the computed base price was greater than published base price minus two dollars (for the BLS study, read percentage of cases in which actual delivered price is greater than 0.95 of the calculated delivered price) is shown in the following listing:[4]

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[1]Melvin de Chazeau apparently was in charge of this study. His explanation of the study appears in TNEC Hearings, Part 27, pp. 14130-14149. The statistical tables are in the same volume, pp. 14343-14428.

[2]The commodities were hot rolled sheets, cold rolled sheets, hot rolled strip, cold rolled strip, merchant bars, cold finished bars, plates, and structural shapes.

[3]Published delivered price equals published base price plus applicable published extras plus rail freight from applicable basing point to consumer's plant.

[4]Two dollars off base price was approximately equal to five per cent. In the BLS frequency distribution, that class interval (width of class interval equalled one per cent) was selected as representing actual price equal to calculated price whose lower limit equalled base price for the quarter in question expressed as a percentage of the base price in April, 1942. For indexes of base prices on this basis, see Iron Age, April 25, 1946, p. 118. Recall that the frequency distributions are for actual delivered price

	BLS 2nd Qtr., 1939	Department of Justice Feb., 1939
Structural shapes	74.3%	76%
Plates	82.0	83
Hot rolled sheets	49.6	45
Hot rolled strip	54.9	62

The agreement between the two studies is very good, as would be expected for periods this close together if the studies were competently made and no violent changes in market conditions had taken place.

A similar comparison is attempted in the listing below showing the percentage of cases in which actual price is equal to or no more than five per cent less than calculated price:[1]

	BLS 2nd Qtr., 1939	Department of Justice Feb., 1939
Structural shapes	64.3%	52%
Plates	66.4	46
Hot rolled sheets	24.1	28
Hot rolled strip	25.8	30

The agreement is still fairly good, although not so close as in the previous listing.

A more interesting comparison of observance is that between the BLS study and earlier data. This comparison will give some indication of the long run change in observance. Four studies are presented: one cited by Fetter, two FTC studies, and the BLS study. Frank Fetter has presented data

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expressed as a percentage of April, 1942, calculated price.

The data for the Department of Justice listing are from TNEC Hearings, Part 27, p. 14425.

[1]The difficulty in this comparison is that in the BLS study those cases in which actual price is equal to calculated price will not necessarily be at the top of the relevant class interval. Hence some cases may be included for which actual price was in fact higher than the calculated price.

for 1919 sales of plates, shapes, and bars.[1] Fetter notes that in the Pittsburgh plus case many witnesses testified they invariably paid the "official" price of the date of sale or in a "few" cases nearly that price within the small range of five to ten cents per hundred pounds. This was true of independents' sales as well as U. S. Steel's. His quantitative data for 1919 on recalculation show that 92.0% of the sales were made within the limits, "base price" plus or minus five cents per hundred pounds. At 1919 prices for bars, shapes, and plates, five cents per hundred pounds is about two per cent of base prices (not delivered price). Fetter's data and the two FTC studies are compared with statistics calculated from the BLS study in Table 23. The BLS frequencies are calculated within the limits of plus or minus two per cent of "base price," although this interval is probably a little too wide.

Granted that this table contains a small amount of data with which to work, it indicates that between the two periods covered there has been a substantial decline in the degree to which the system is observed when there is unused capacity. That is, the flexibility of observance over the cycle has increased. In the year 1919 and the second quarter of 1939, the amount of idle facilities "threatening" the market, as indicated by ingot production, was about the same, and yet the comparable percentages for observance are ninety-two and sixty respectively. The regular relation between

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[1] The data are presented in the form of a "target" chart on p. 173 of Masquerade of Monopoly. This chart is inadequately described, but A. R. Burns, p. 303 of Decline of Competition, states that transactions took place in 1919 and that the commodities covered were plates, shapes, and bars. It is also the case that Fetter's percentages are not consistent with the number and location of the dots on the chart unless some of the dots on the chart are actually in the "unspecified" class. This assumption has been made in recalculating the data in a form comparable with that of the BLS study already discussed.

TABLE 23

RELATIVE FREQUENCY OF SALES PRICES OF PLATES, SHAPES, AND BARS WITHIN ±2% OR ±3% OF QUOTED PRICE

Study	Period	Total industry ingot production; per cent of capacity	Average: plates, shapes, and bars		Plates	Shapes	Bars
			± 2%	± 3%*	± 2%	± 2%	± 2%
BLS	2 Qtr. 1942	98%	93.4%	(93.4%)	85.9%	96.6%	97.7%
	4 1941	98	87.8	(89.9)	82.4	89.8	91.2
	2 1941	98	81.7	(86.4)	81.4	74.8	88.8
	2 1940	72	72.4	(76.8)	70.6	67.0	79.7
	2 1939	51	60.0	(67.4)	62.8	61.8	55.4
Fetter	1919	54	92.0				
FTC**	1902-22	73****		(90.1)			
FTC***	"Over a number of years" assumed to be 1902-22.	73		(92.4)			

*Over the period, 1902-22, ± 5¢ per hundred pounds (the form in which the FTC data are expressed) is equivalent to about ± 2.6% of base prices. It is not known how the various years are weighted in the FTC studies cited in the last two lines of this table, but the relative frequencies for the BLS study were also calculated on the basis of ± 3% of quoted price. These figures are shown in parentheses.

**FTC Decisions, Vol. 8, p. 31. 3502 sales were analyzed "over many years from 1902 to 1922" including sales by independents and U. S. Steel subsidiaries.

***Ibid. This study covered 3700 sales by the Illinois Steel Co. (U. S. Steel).

****Unweighted arithmetic mean of separate years.

ingot production and the column showing average percentages in the BLS study indicates that the second quarter 1939 is not a freak phenomenon. Note also that the observance percentages in the two FTC studies cited are much higher than for the second quarter of 1940 which had an output relative to capacity comparable to that of the period 1920-22.

Conclusions on Price Flexibility and the Degree of Monopoly

The relationship underlying the earlier discussion of the flexibility of actual prices is that the flexibility of actual prices over the cycle equals some measure of the flexibility of quoted prices times a measure of the flexibility of observance of quoted prices. More completely, the flexibility of quoted prices over the cycle should be regarded as made up of the sum of flexibility of base prices plus the flexibility of extras, each of these being properly weighted.[1]

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[1]Perhaps an example using simple definitions of flexibility and observance will clarify this relationship. Consider changes between the peak (time zero) and trough (time one) of a cycle.

B Base price
E Extras
Q Total quoted price
A Actual price

$$\text{Level of observance} = \frac{A_t}{Q_t}$$

$$\text{Flexibility of observance} = \frac{A_0}{Q_0} \cdot \frac{Q_1}{A_1} = \frac{A_0}{A_1} \cdot \frac{Q_1}{Q_0}$$

$$\text{Flexibility of price} = \frac{P_0}{P_1}$$

Weights:

For base price: $k_b = \frac{B_1}{Q_1}$

For extras: $k_e = \frac{E_1}{Q_1}$

The material in this chapter has been concerned with two of the terms in this relationship, the flexibility of base prices and the flexibility in observance of quoted prices over the cycle. The data indicated no long term change in the flexibility of the base prices studied, as indicated by the coefficient of variation, while at the same time flexibility of observance of quoted prices increased substantially.[1] The conclusion that the flexibility of actual prices has increased over the period studied is reasonable in view of the considerable change in the flexibility of observance that appears to have taken place. It is possible, on the face of it, that the combination of changing weights (flexibility of base prices should be weighted less in later years relative to the weight assigned the flexibility of extras) and change in the flexibility of extras could result in a decrease in the flexibility of total quoted price. In this case, the flexibility of actual price need not necessarily increase even though the flexibility of observance has increased. Assume now that the flexibility of base prices was greater than that of extras in the earlier years of the period, as seems reasonable. If, in the later part of the period, flexibility of base prices is unchanged and the flexibility of extras declines, flexibility of total quoted price must decline. On the other hand, if the flexibility of extras increased, the flexibility of total

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Flexibility of actual price, $\frac{A_0}{A_1}$ =

$$\left(k_b \frac{B_0}{B_1} + k_e \frac{E_0}{E_1}\right)\left(\frac{A_0}{Q_0} \cdot \frac{Q_1}{A_1}\right) = \frac{Q_0}{Q_1}\left(\frac{A_0}{Q_0} \cdot \frac{Q_1}{A_1}\right)$$

The first factor is the flexibility of quoted price and the second factor is flexibility of observance.

[1] Flexibility as measured by the relative frequency of price change did give indication of a decline over time. Flexibility in the amplitude sense is the relevant measure here.

quoted price may have increased or decreased.[1] If it has increased, the weight to be attached to base price flexibility is still so much greater than the weight for flexibility of extras that the possible reduction in the flexibility of total quoted price is very small.[2] These considerations strengthen the conclusion that the flexibility of actual prices has increased, because the flexibility of quoted price has remained about the same while the flexibility of observance has increased. If the hypothesis discussed at the beginning of this chapter is correct, namely, that price rigidity is positively correlated with the degree of monopoly, the conclusion must be that the degree of monopoly has declined slightly over the period.

The Behavior of Profit

Thus far we have examined concentration in capacity and value added and base price behavior and observance. It is also possible to secure profits data for three firms over almost the whole half century. These data provide some additional corroboration for the results already found.

The profit measure that would best show the success of a firm is the rate of return on investment, properly defined. In the case of steel, the

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[1] The decrease is possible because of the changed weights.

[2] In the period 1939-42, the ratio of base price to extras was 79 to 14. This average is based on sheets, strip, bars, plates, and shapes. (See Fazar and Bean, op. cit., p. 119.) Using definitions in the third preceding footnote, make the extreme assumptions that the weights in the earlier period were 99 to 1 and that flexibility of base prices was 1.5 while the flexibility of extras was 1.0. The flexibility of total quoted price would be $1.495 = \frac{99\,(1.5) + (1 \times 1)}{100}$. In the later period, if weights are 79 to 14, any flexibility of extras less than 1.467 would cause flexibility of total quoted price to be less than in the earlier period as can be seen from $\frac{79\,(1.5) + 14X}{93} = 1.495$. But the decline is not great, because even if the flexibility of extras stayed at one, an unreasonable assumption, flexibility of total quoted price would be $1.42 = \frac{79\,(1.5) + (14 \times 1)}{93}$. Freight has been neglected.

deficiencies of the investment data are so glaring as to make use of this measure inadvisable. The price level and "water" problems are the two most obvious difficulties. The rate of return on sales will be more informative. There are two difficulties in interpreting this quantity, either when comparing different firms or comparing changes for the same firm through time. First, a change in the ratio of bonds (more generally, all borrowed capital) to owners' equity can produce spurious changes if net profits are used in computing the return on sales. The return on sales can change while the return on total investment remains constant. This difficulty can be met by taking net profit before interest. The second difficulty cannot be disposed of so easily. If the ratio of assets to sales changes, the rate of return on sales might be constant while the rate of return on assets is changing. This difficulty manifests itself in various ways, perhaps as the result of differing product structures or as the result of different productions methods which give about the same total unit cost but which use different proportions of labor and capital.

The rate of return on sales has been calculated for U. S. Steel (1902-48), Bethlehem (1905-48), and Republic (1905-27 and 1930-48).[1] Profits taken from TNEC Hearings, Part. 31, have been adjusted by FTC for capital gains and losses and other charges or credits to current income properly considered surplus adjustments.[2] Profits from the annual reports have not been adjusted in these ways. Nor has any adjustment been made for the accelerated depreciation policy adopted by U. S. Steel and Republic in 1948, affecting 1948 and 1947. Our findings would not be altered by such adjustment. Profits

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[1]The ratios for U. S. Steel and Bethlehem have been calculated from data given in their 1948 annual reports. For Republic, 1930-48 are calculated from the 1948 Annual Report; 1917-27 from TNEC Hearings, Part 31, p. 17861; and 1905-17 from data in Moody's Industrials.

[2]See Joint Committee on the Economic Report, Basic Data Relating to Steel Prices (1950), p. 23.

are taken after all taxes and before interest. The sales figures used are presumably consolidated. The data are given in Table 24.

These data show that the average annual ratio of profits to sales was lower for each company from 1919 to 1928 than it was in the years 1905 to 1914. The difference is of the order of two per cent (absolutely) for Bethlehem and Republic even if 1929 is included in the second period. For U. S. Steel the ratio declined by a half. For the period after 1929, the rates of return on sales are lower for all three companies than they were in the 1920's. The most striking feature of these data, however, is the large difference between the ratio for U. S. Steel and those of the other two companies in the early years and the substantial narrowing of this difference. In the years following World War I, the rates of return on sales for the three companies were on about the same level.

An adequate interpretation of this decline in U. S. Steel's rate of return on sales would require much more quantitative information on the behavior of prices relative to costs and on the behavior of costs and output than is now available. The interpretation would probably involve two main elements, however. First, U. S. Steel utilized its capacity more fully in the earlier years than did the independents. An examination of the ratio of independents' ingot output to U. S. Steel's ingot output (each expressed as percentage of capacity) shows a sharp upward trend in the early years with a diminishing rate of increase. This can be taken to indicate that the independents were operating at outputs so much less than those which would minimize average total unit cost that fixed cost per unit was high. If prices of outputs and inputs did not change, then as the independents more fully utilized their plants, the result would have been an increase in the rate of return for the independents. But the difference between the rates of return

TABLE 24

RATIO OF NET PROFIT (BEFORE INTEREST) TO SALES FOR THREE LEADING STEEL COMPANIES[a]

	U.S.S.		Beth.		Republic			U.S.S.		Beth.		Republic	
1902	26.4%		-		-		1924	12.2		9.0		6.9	
03	20.3	21.8[b]	-		-		25	11.5		9.8		9.5	
04	18.6		-		-		26	13.3	12.6	10.6	9.9	11.6	9.3
							27	11.9		9.9		9.1	
05	24.0		20.4%		7.7%		28	13.9		10.0		na	
06	26.4		8.0		12.3								
07	26.6	25.1	8.8	11.6	13.5	11.4	29	19.4		15.3		na	
08	23.2		10.7		12.9		30	13.3		11.7		.1	
09	25.1		10.3		10.4		31	3.4	1.0	3.9	3.5	-6.0	-5.9
							32	-22.9		-11.8		-16.5	
10	24.0		13.7		11.8		33	- 8.4		- 1.6		- 1.1	
11	20.0		12.2		10.2								
12	16.3	18.9	12.1	14.0	6.4	9.9	34	- 4.0		4.3		- .3	
13	20.4		16.0		12.4		35	1.1		5.8		5.8	
14	13.7		16.1		8.6		36	7.0	2.8	6.9	6.1	6.6	3.1
							37	9.7		9.1		5.6	
15	20.8		13.6		14.6		38	.1		4.6		- 2.4	
16	33.6	21.5	21.8	13.3	29.7	19.2							
17	19.9		12.0		21.2		39	6.0		7.7		6.4	
18	11.6		5.7		11.3		40	10.7	8.1	9.3	7.1	8.3	6.9
							41	7.5		4.2		5.9	
19	9.5		8.8		6.3								
20	10.8		8.1		10.4		42	4.2		2.3		4.1	
21	9.0	10.0	13.0	9.9	-23.4	1.9	43	3.5		2.0		2.8	
22	8.4		9.9		3.3	(8.2)[c]	44	3.2		2.5		2.5	
1923	12.5		9.7		12.7								
							45	3.5		3.1		2.3	
							46	6.2		5.6		4.3	
							47	6.1		5.3		5.1	
							1948	5.3		7.2		6.3	

[a]The percentages were calculated by slide rule.

[b]This, and other similar figures, is the arithmetic mean for years indicated by the brace.

[c]Average, excluding 1921.

on sales for U. S. Steel and the others was eliminated not in this way but by a decline in U. S. Steel's rate of return. The other necessary element in the interpretation is a decline in prices of outputs relative to inputs. These two elements taken together would permit the independents' rate of return on sales to remain roughly constant while U. S. Steel's rate of return declined.

There are, of course, other ways by which the behavior of the profit ratios could be accounted for. If U. S. Steel's ratio of assets to sales had declined relative to the ratio for the other firms, a decline in U. S. Steel's return on sales would not require any change in prices relative to costs nor any change in return on assets. This change in the ratio of assets to sales could have been produced by a shift to production methods using less capital or by a decline in vertical integration. The magnitude of the required changes would be very great, however. Another possibility is that U. S. Steel simply suffered a large decline in efficiency. But if the other companies outstripped U. S. Steel in efficiency, then a decline in prices relative to costs would also be required to leave their rates of return constant.

The tentative nature of the above discussion is quite evident. Once again, the decline in the leading position enjoyed by U. S. Steel is emphasized. Before the first World War, there appears to have been a slow and steady pressure on U. S. Steel, perhaps consistent with good observation of basing point pricing on the whole, but strong enough gradually to erode U. S. Steel's position, until by the twenties the competitive structure of the industry, as indicated by return on sales, differed considerably from that of the years before World War I.

Collusive Bidding

Evidence of collusion in bidding on government contracts usually comes in the form of tie bids, with the ties customarily resolved by the drawing of lots. Collusion may be present, of course, without tie bids to betray its presence. Consequently, the volume of tie bids may not fully indicate the extent of collusion.

No data are presented here to show whether collusion expressing itself in tie bids has become more or less common over the years. Because of interest in even rough estimates of the extent of such collusion, it is worth while to digress a moment to examine two pieces of evidence on this matter.

In 1939, U. S. Steel stated,

> An examination of records, covering Federal Government awards for steel products made at Washington, D. C. during 1938 and the first quarter of 1939, indicates that such awards aggregated approximately $10,550,000, of which about 80% in value went to the lowest bidder and only about 16.5% in value by lot on account of identical bids. The balance of 3.5% was awarded on a basis other than of price.[1]

The data supporting this statement were turned over to the Federal Trade Commission.[2] FTC reclassified this data so as to include only steel products and to divide this category into rolling mill products and all other steel products. Judging by the FTC results,[3] the origin of the $10,550,000 figure mentioned in the quotation is a mystery as is also the 16.5% for awards by

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[1] TNEC Hearings, Part 27, p. 14640. The statement is part of U. S. Steel's exhibit, "The Basing Point Method of Quoting Delivered Prices in the Steel Industry."

[2] The data appear on pp. 14444-505 of TNEC Hearings, Part 27. Apparently these lists of awards came from records kept by the subsidiaries of U. S. Steel. Since they are arranged by U. S. Steel subsidiaries, it is concluded, in the absence of any clarifying statement, that the only awards included are those on which a U. S. Steel company submitted a bid.

[3] TNEC Hearings, Part 27, p. 14538.

lot. FTC results indicate fewer lot awards than this, as is shown in Table 25. By the value of award measure, identical bids are more frequent

TABLE 25

PERCENTAGE OF TOTAL VALUE OF AWARDS BY U. S. GOVERNMENT ON WHICH U. S. STEEL COMPANIES BID AND WHICH WERE MADE BY LOT DURING 1938 AND THE 1ST QUARTER OF 1939

	Rolling Mill products	All other steel products
Awards received by rolling mills	12.7%	1.6%
Awards received by others	16.3	9.6
All awards	13.4	2.3

in what the FTC identified as rolling mill products than in All Other Steel Products. Curiously, tie bids were more frequent in those cases in which the award was made to firms not possessing rolling mills.[1] This difference, if significant, is consistent with either of two quite different hypotheses: (a) rolling mills observe the basing point system less closely in bidding on government contracts than do non-rolling mill companies, or (b) in bidding on government contracts, rolling mill companies engage in collusion of a greater degree than that implicit in the observance of a basing point formula, that is, they more often determine beforehand which bidder is to be low, thus avoiding the tell-tale tracks of identical bids. It is perhaps better that choice between these, and other hypotheses, be deferred until more evidence is available.

[1] Actually, this group is made up of firms not listed in the 1938 Iron and Steel Works Directory.

If each award is not weighted by its value but is given the same weight (i.e., an analysis of frequency of awards) the percentages are increased in each cell of the table except for rolling mill product awards to others.[1]

TABLE 26

RELATIVE FREQUENCY OF "LOT-TIE" AWARDS ON U.S. GOVERNMENT CONTRACTS, 1938 AND 1ST QUARTER 1939

	Rolling Mill products	All other steel products
Awards received by rolling mills	26.8%	13.1%
Awards received by others	8.8	13.3
All awards	22.1	13.2

On the basis of these data, it is difficult to tell if observance of the basing point system is greater in bidding on government contracts than it is on sales to private firms. The usual contention is that publicity of bids will increase the degree of observance in bidding on government contracts. In those cases in which the winning bid is not a basing point bid, there may be higher identical bids which conform to the formula and which are not revealed in these tables.[2]

[1] The percentages are calculated from data in TNEC Hearings, Part 27, p. 14539. Errors have been corrected.

[2] According to another study, such cases of identical bids are 57% as frequent as those in which the identity is among the low bids. This study covered government purchases of iron and steel and their products, not including machinery, during a one year period following December, 1937. See TNEC Monograph No. 19, Government Purchasing, p. 315.

The impression is sometimes given that identical bids are the usual thing in bidding on government contracts.[1] Instances of identical bids are spectacular because they would be extremely improbable in the absence of any collusive device.[2] They are surely frequent enough in an absolute sense to constitute a serious problem, but the data cited do not support the contention that identical bids are the rule or even approach this situation.

It should not be necessary to belabor the point that identical bids are collusive, but a spelling out of this contention may still be useful, for it makes clear the collusion that is inherent in any basing point system that operates according to plan, whether selling to private firms or the government. It will indicate also why the degree of observance of the system, given the degree to which base prices are responsive to changed conditions, is an important issue.

Consider first the ordinary auction. Here the winning bidder will be the one with the highest demand price, but he will not have to bid this price but a price equal to or just above the next highest demand price. In the counterpart of this situation where there is bidding on a government

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[1]For example, Machlup cites the Navy bid opening of May 26, 1936, for some steel (see TNEC Hearings, Part 27, p. 14548) in which all submitted bids were identical. Machlup states, "The officers in charge were not surprised. They knew it was no strange accident that all bidders had submitted identical bids. Indeed, they had come to expect such 'precise calculations' on the part of all 'competing' firms in the steel industry. Since no bid was the lowest, the order had to be awarded by drawing lots. . . . There were exceptions /to cases of identical bids/, to be sure. But as a rule identical delivered prices were quoted no matter how many competing firms submitted bids." Machlup, op. cit., p. 2.

[2]And some are amusing. In 1936 bids were submitted on some pipe for a PWA project. Two bidders carried their calculations to three digits after the decimal point instead of the customary two. This would still have resulted in identical low bids but for the fact that one of these two firms also made an arithmetical mistake. The winning bidder was low by twelve cents on about $60,000 worth of pipe! See TNEC Hearings, Part 27, pp. 14293-4.

contract with no collusion among bidders, each bidder will have a supply price for quantity specified. His supply price will depend on his estimate of the additional cost he would incur by having to produce the quantity he bids for, that is, his marginal cost. The determination of this supply price is no simple or routine affair. It can vary widely, depending on his circumstances of the moment. The orders already on his books play an obvious part. Orders he hopes to get in the future may affect his supply price, for if he wins the bidding, he may not get that contribution to overhead which these orders might have made. It is obvious that the supply prices of even any two of the different bidders would be identical only by a freak of chance. The winning bidder will be the producer with the lowest supply price, but he will not have to bid this price, but one equal to or just below the next lowest supply price. For this result, rebids must be possible. Hence, this situation does not describe sealed bid procedure.

Sealed bid procedure is the counterpart of the Dutch auction. In this type of auction, the auctioneer first announces a high price, then successively lower prices. The first buyer to speak wins the auction. Here it is not necessarily the case that the buyer with the highest demand price will win the auction, for the price at which a bidder decides to speak will depend on his estimate of the highest price at which some other bidder will speak. His demand price will set an upper limit, of course. It may also result that the buyer with the highest demand price wins and bids a price above the next highest demand price, provided his estimates of the "speaking" prices of other buyers are erroneously high. This situation is not altered in its essentials if the buyers submit sealed bids, provided their estimates of the prices at which other buyers will speak are not affected by this change in procedure.

The sealed bid procedure on government contracts is the precise

counterpart of the Dutch auction. The firm with the lowest supply price may or may not win. If there is no collusion of any kind, the likelihood of any identical bids is extremely remote. Each bid depends on two things: the supply price and the estimate of the other bidders' speaking prices. Neither of these, if an honest estimate is made, can be determined entirely by any systematic or mechanical procedure. If identical bids are found, they indicate either collusion at the time or previous agreement, perhaps tacit, to pursue a common course of action. Use of a basing point system is an example of the latter sort. It involves an implicit agreement to quote the known applicable base price and to be content with awarding of the contract by lot. The final price may even be above everyone's supply price (based on marginal cost), depending on the height of the base price. The supply price will have nothing to do directly with the final price. Supply price may decide a firm not to bid at all if it is above the base price. Finally, if the basing point system is observed, these remarks apply equally to private sales made under the system.

Summary

Before connecting the findings of this and previous chapters, mention should be made of some non-quantitative evidence on price cutting and agreements.[1] Taken by itself, this material, drawn mainly from Iron Age, does not show a clear pattern of change since the beginning of the century. It is helpful, however, in arriving at a summary interpretation of this period, tentative as this interpretation must be.

The publicly available evidence on agreements in steel has certainly diminished over the years of this century. This does not necessarily indicate

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[1]This material is presented in the appendix to this chapter.

that agreements are less prevalent now than formerly, although this is very probably true. But the examination of agreements has more significance than merely to indicate that publicly available evidence has become less plentiful. The more detailed and restrictive types of agreements which were prevalent during the first several years of U. S. Steel's existence apparently have disappeared. Some of the penalties to enforce compliance are no longer used. Pools are now out of fashion. Agreements in later years have had to be hidden or disguised or legislative sanction has had to be obtained. The obstacles to agreement are surely greater than they were and the coercion of recalcitrants is attended by greater danger, for whatever opinion may be held with respect to the adequacy of anti-trust law enforcement, it has certainly improved and must be counted of some effect.

I have the impression that more instances of price cutting are reported in Iron Age in the first half of the period than in the last half. A part of this decline may be attributable to a change in the reporting practices of Iron Age. In the later period, more attention is given behavior of various aggregates with a consequent dilution of information. But even so, on the basis of the reports as they stand, the conclusion that the significance of price cutting has declined would be unwarranted. It is possible that there are more reports of price cutting (as against instances) in the earlier period because the attempt to hold up prices was more active and vigorous. Price cuts in such a situation become more newsworthy.

To see the earlier period in the proper light, price cuts and agreements should be considered together. The sporadic outbursts of price cutting drew attention and agreements were necessary because a vigorous attempt was being made to maintain a geographic price structure that was becoming more and more at odds with the realities of the situation. After the change in

geographic price structure in the early 1920's when Pittsburgh plus was abandoned, the formal price was less at variance with the location of production and markets. While the new structure may not have been any more flexible in a temporal sense, it appears that either the attempt to enforce it was less vigorous or the result was less successful, resulting in the decline of observance that has been pointed out. In terms of the effectiveness with which competition was working, the earlier period stands in rather clear contrast to the later period. There is little in the later period comparable to the anti-competitive efforts prior to World War I, and the evidence on price behavior that has been examined does not support the view that less obvious efforts to restrain competition have been successful to the same degree.

As a part of the asserted improvement in the state of competition in the industry, the position of U. S. Steel has changed. Especially in the opening years of the century, it was the important force behind price maintenance activities. It is true that officials of the Corporation denied this, but it seems clear from a reading of the record that officials in the subsidiaries were either unaware of the Corporation's policy or chose to ignore it. After the passing of Pittsburgh plus, the Corporation continued to act as price leader, but it was a much less vigorous leadership. None of the data examined refutes the general conclusion that the state of competition in steel has improved. But it is difficult to elaborate this conclusion and show close correspondence of movement through time among the various data.

Considering gaps in data, perhaps the most that can be said is that the findings of this and the preceding chapter are not inconsistent with the behavior of the concentration coefficients for steel ingot capacity. The course of concentration in steel ingot capacity would lead to the expectation

that the intensity of competitive forces grew until some time in the early years after World War I. This dating cannot be made with much confidence, but the breakdown of Pittsburgh plus is considered to be of major significance. The examination of collusive bidding was of no aid, of course, in detecting long term change. The rates of return on sales, including only the three largest firms, give clear indication of major changes in the first twenty years or so of U. S. Steel's existence, but after that little can be inferred from them.

Granting these uncertainties, it is my feeling that the early twenties mark the end of a period, although not a time of rapid change in competitive structure. Rather, the change appears to have been slow and persistent. As for the period following the introduction of multiple base pricing, the concentration coefficients for steel ingot capacity remained on about the same level. The other evidence that has been presented is consistent with this, but there are large gaps. The data on concentration in "value added," going back only to 1919, showed a continued change in the strength of U. S. Steel as compared with the next seven largest firms, but this was not enough to produce more than a suggestion of a continued decline in concentration of value added. The examination of price flexibility and observance indicated that a change toward competition had taken place, but the time of change is uncertain because of large gaps in the data on observance. Whether the intensity of competition was at about the same level over the whole period after the early twenties cannot be told from our data. Perhaps competition was somewhat more intense in the thirties, but this is only conjecture.

APPENDIX TO CHAPTER V

QUALITATIVE EVIDENCE ON THE BEHAVIOR OF THE BASING POINT SYSTEM

The quantitative material of the preceding chapter can usefully be supplemented by qualitative evidence on first, the frequency and severity of price cutting activity and, second, the prevalence of agreements to maintain price. If a basing point price system works according to plan, that in itself may be taken as evidence that there is agreement, perhaps tacit, on pricing procedures, some aspects of which are inimical to economic welfare. One of the more serious of these is the agreement to observe base prices without under-cutting. But the system may not work according to plan and the implied agreement may be of varying degrees of effectiveness. It may be necessary to bolster the system with something more than tacit agreement.

An attempt to examine agreements may seem superfluous in view of the fact that some evidence on observance has already been discussed, but agreements of a specific nature may be more than merely the obverse of defections from the system. For example, if in a basing point system base prices move up and down as they would if there were no such system, observance of the system will be very good, yet it could hardly be maintained that the agreement implied in this basing point system has very serious consequences for buyers. But in a system in which base prices are determined in concert so as to maximize profits under the system and if the system is observed, observance will be no higher than in the former case, but buyers are much worse off.

Agreements in connection with a basing point system would seem to serve two purposes. First, it may be the case that a higher level of base prices can be set with agreement than without it. Secondly, whatever the level of base prices set, subsidiary agreements may prevent defections. The

effectiveness of subsidiary agreements to secure adherence to the system would determine the maximum effective level of base prices that might be set (effective in the sense that it would be well observed), but additional agreement on prices themselves might be necessary to actually establish this level. Needless to say, it is not maintained here that a higher level of prices will always be associated with a higher profit for the group.

In addition to the possible connection between agreements and the level of base prices, a study of agreements to secure compliance with the system is useful if only to see whether the change in these agreements is consistent with the previous suggestions on long run changes in the extent to which the system is observed.

The succeeding material on price cuts and agreements will be presented in roughly chronological order. The first period covers the early years of the century up to about 1911.

The various issues of the trade publication, Iron Age, make instructive reading for the student of secret price cuts. While the comments of writers in Iron Age cannot be satisfactorily quantified, it would be a serious mistake to neglect them. When a report on a market informs the reader that "price concessions have been widespread" or that "prices were holding well," useful information is conveyed which is of aid in the formation of judgments about these factual matters, granted that a precise description of the relevant facts would be more desirable if it could be managed.

The material that has been selected will be presented in chronological order with the date given first and the page number of the reference immediately after the initials "IA" (for Iron Age). There is also some material from TNEC sources.

11-7-1901 IA 46

> It is evident that competition is having a weakening effect on the market [for nails], and concessions are being made of from ten to fifteen cents a keg.

1-2-1902 IA 34 (Refers to 1901)

> There has also been a price agreement on steel and iron bars, the latter having more recently gone into effect, and which have worked fairly satisfactorily, only occasional cutting in established prices being reported.

1901 was a good year for bars.

1-7-1904 IA 74 (Refers to 1903)

In the first half of 1903, steel business was brisk, but it was dull in the second half. The following comment ascribes influence to the "large interests" in maintaining prices, but some declines were forced upon them:

> When the era of depression set in, along in June or July, the decline in prices in certain branches was rapid, in spite of the efforts of the large interests to hold the market. . . . the market was held very much better than it would have been under conditions which existed before the organization of the Steel Corporation. It would be folly to expect any interest, no matter how large, to thoroughly control prices, much less demand; but it has been demonstrated that the Steel Corporation, with their huge interests, are an important factor in steadying a market when there is a very limited demand and the tendency of prices is decidedly downward. It is safe to assume that the year 1903 would have closed with very much lower prices all around had it not been for the efforts of the large interests to sustain the market and for the shut down movement in pig iron, which was inaugurated in the Central West early in October with such beneficial results.

1-5-1905 IA 82

Here it is said that the official rail price (standard section) did not vary in 1904 and will be the same in 1905. It is believed that the official price was kept, but concessions were given in the shape of low prices on angle bars, bolts, and spikes. This means of cutting the rail price indirectly was used in an earlier period by Andrew Carnegie to evade his pool obligations.

It is noted here that the prices of finished products controlled by

"powerful associations" varied less in 1904 than those not so controlled.

In steel and iron bars, it is stated that a "powerful association" is at work. But independent mills, notably International Harvester and Inland, did at times cut below the association mills. When the association price was 1.51½¢, Harvester sold as low as 1.25¢ (a sixth lower), but the differential lessened as the market grew stronger.

In hoops, three firms produced ninety per cent of the hoop output. They had an agreement, but internal warfare arose and hoops tumbled eight dollars per ton in five weeks. By June, prices were in the same vicinity as at the beginning of the year.

1-11-1906 IA 182

While there was little competition in plates, rails, shapes, bars, and some other products, there was very keen competition in sheets and tin plates. The independents and U. S. Steel were at odds. The independents charged U. S. Steel with being unduly sensitive to loss of a customer when independents cut price.

1-7-1909 IA 31 "The Philadelphia Iron Trade in 1908"

> Ruinous price cutting was avoided [in the pig iron trade under the auspices of Judge Gary], and, while producers who considered themselves on the outside made marked concessions from time to time, which were ultimately met by those who had held consistently together, it was with a unanimity heretofore unknown in the trade that such action was taken.

On page thirty-four:

> A most unsettled market has characterized the bar iron trade almost throughout the year. Makers in the East were apparently unable to agree on any price basis and maintain it for any length of time, and frequently the market was wide open.

1-6-1910 IA 28 "The Pittsburgh Iron Trade in 1909"

From October, 1907, to April, 1909, there was severe depression.

Iron Age bows to U. S. Steel for its part in preventing absolute demoralization

of prices. By late 1908 and early 1909, however, it became evident that consumers were holding off because they thought the situation was "artificial." For several months prices had been more or less shaded. At a meeting of the leading steel interests in February it was decided to abandon efforts to hold prices. Then began a scramble for orders and contracts, "the equal of which this country has never seen." Once consumers were convinced bottom had been reached (April) a buying rush set in. In May and June order books were filling up and prices began to improve. Sample price reductions: plate and structural material by $6 - 7 per ton; steel bars by $4 - 5 per ton; pipe by $10 - 12 per ton. These were reductions in the vicinity of 15 - 20%. This appears to be more than the sixty day episode as interpreted by de Chazeau.[1]

1-5-1911 IA 59 "The Philadelphia Iron Trade in 1910"

The prices of steel bars were quite steady throughout the year, "although concessions were at times available from independent producers."

1-5-1911 IA 56 "The Pittsburgh Iron Trade in 1910"

Prices on finished iron and steel were fairly well maintained by reason of cooperation between the leading producers until the last three or four months of the year, when they commenced to give way to some extent. This resulted in a series of meetings of makers of sheets, tin plates, bars, plates, and structural steel in Pittsburgh in December. At this time it was decided to try to hold present prices, the belief being that early in 1911 the demand would show material betterment.

On page 57: "Concessions in prices were being freely made in October and November, and it became evident some concerted action would be necessary to hold the market, as previously referred to."

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[1]Daugherty, de Chazeau, and Stratton, op. cit., p. 540.

6-8-1911 IA 1407 Testimony of John W. Gates before the Stanley Committee. (His remarks refer also to the period before 1911.)

> The Chairman. Does not the open shop fellow sell at the same price, practically, as the corporation [U. S. Steel] sells at? [By open shop he refers, not to a labor arrangement, but to an independent firm.]
>
> Mr. Gates. Not necessarily. I have occasionally bought some of these products in Texas, and I write to the Pittsburgh Wire Co. and the Pittsburgh Steel Co. and the corporation, and I generally get a lower price from one of the outside concerns. The prices are not the same by any means.
>
> The Chairman. What is the difference of price between these outside concerns and the corporation? Is it material?
>
> Mr. Gates. Oh, yes.

He then avers that 10¢ a keg on nails ($50 per car) would be material. Mr. Stanley then asked him how the corporation could hold its business if they were undersold. Gates intimated that the corporation might be able to exert some pressure because it handled "a pretty full line of goods" while the independent did not do so to the same extent.

1-4-1912 IA 59 "The Chicago Iron Trade in 1911"

Prices held well until June. In June, a leading steel bar maker placed contracts with Western bar users at a reduction of three dollars per ton. The bar market followed this cut. Weaknesses began to appear in plates and shapes. "The keenness of unhampered competitive selling grew apace." Around October first, a reduction of two dollars was announced on plates and shapes. There were wide irregularities in prices of sheets.

During the last half of the year, quotations for Western delivery departed from the Pittsburgh basing price. The freight differential, especially on plates, shapes, and bars, "was sacrificed in proportion as the particular sale required." In extreme cases, the Chicago price was one to three dollars below Pittsburgh price plus freight to Chicago. It is noted that since November, with some recovery, there has been a tendency to resume Pittsburgh base price.

In the preceding excerpts from Iron Age, there are two things that should be noted. First, the main force attempting to prevent price cuts was undoubtedly U. S. Steel. This may not be readily apparent in the quoted passages, because Iron Age, especially in the early years of U. S. Steel, was very circumspect whenever writing of the Corporation's activities. The Corporation was often referred to by indirection, although reference to it must have been unmistakable to regular readers of the publication. The role ascribed to U. S. Steel is not, of course, a new finding. It is mentioned here because I think that U. S. Steel's position in the industry changed from an active and rather aggressive leadership in its early years to a more passive adaptation to changes as the years progressed. The second development to note is the breaks in the price structure attributed to Western mills. The Western branch of the industry was gradually growing in strength and by the early 1920's became strong enough to bring about a major change in the industry's price structure.

During this same period, the structure of agreements in the steel industry was very elaborate and some pools continued to operate in spite of the decision in the Addyston Pipe Company case in 1889 which clearly outlawed them.[1] What is set down here is not very different from the usual narrative of agreements over these years. Perhaps the most striking result of an attempt to catalogue agreements in this industry is the amazing (i.e., it is amazing to one who did not live through that period) extent to which the Sherman Act was ignored or defied during the first seven (ten or eleven?) years of this century.

Using as our sources Iron Age and the hearings of the Stanley

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[1] U. S. v. Addyston Pipe Co. (175 U. S. 211)

Committee,[1] we find pools or non-tacit price agreements in operation that were either uncovered by the committee or important enough to receive notice in Iron Age from 1900 to 1907 in the following products: billets, rails, bars, sheet and tin plate, and pig iron. In addition, agreements were in operation from 1900 to 1905 in structural shapes, plate, and ore. There was a shafting agreement which was in operation through 1904. In 1905, Iron Age reported an agreement in hoops.[2] It is reasonable to suppose that this agreement had been in operation in the immediately preceding years. A witness declared before the Stanley Committee that his firm had been a member of the Wire Rope Association in 1905 and 1906.[3] This association was no information service, but existed for the purpose of fixing prices and dividing territory. It appears that this agreement probably continued to function until 1908. After 1908, Iron Age no longer seems to have reported these agreements if they continued in their earlier forms. That meetings continued to take place which were concerned with prices is not in doubt. In fact, in 1910, after a decline in sales during the last three or four months of the year, Iron Age reports that "this resulted in a series of meetings of makers of sheets, tin plates, bars, plates, and structural steel in Pittsburgh in December, at which it was decided to try to hold present prices, the belief being that early in 1911 the demand would show material betterment."[4] The significance of the Gary dinners will be discussed at a later point.

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[1]The Stanley Committee, House of Representatives, investigated U. S. Steel for an extended period beginning in 1911.

[2]Iron Age, Jan. 5, 1905, p. 82.

[3]Stanley Committee Hearings, p. 562.

[4]Iron Age, Jan. 5, 1911, p. 56.

Three of these agreements, those in structural shapes, shafting, and plate, operated as pools through 1904 with penalties for exceeding quotas, at which time the penalty features were abandoned and the funds distributed among the members, including the initially paid "earnest" money. The members continued to make reports to the "commissioner" of these pools, and the plate and shapes groups are reported as operating under a price agreement in 1905.[1]

In 1901 billets are reported as a pool rather than a price agreement.[2] In good years, the billet pool appeared to be inoperative, as in 1905 and the latter part of 1901.[3] In 1904 billets are again reported as a pool, but in the following year only a price agreement is mentioned.[4] In 1908, no mention is made of a pool, but agreement on prices was reached in late 1907 and it was effective.[5]

In 1905, a rail pool is reported rather than only agreement to maintain price. Lackawanna Steel, which had just completed a new rail mill in Buffalo, was allotted a larger percentage in the pool at that time.[6] The price of rails is the stock example of a rigid price, of course, and remained at $28 from early 1901 until 1914 according to Iron Age price reports. The record in later years is not much better. The reasons for this rigidity rest in part on the small number of producers and on opportunities for price cutting provided by reciprocal trading and concessions on accessories and other products. There appears to be no public record of a pooling agreement after

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[1] Iron Age, Jan. 4, 1906, p. 102 and Stanley committee Hearings, pp. 1712-18, 551-80, and 685. The reports of the Steel Plate Association appear in pp. 695-782 of the Hearings.

[2] Iron Age, Jan. 3, 1901, p. 34.

[3] Ibid., p. 34 and Iron Age, Jan. 14, 1906, p. 102.

[4] Ibid., Jan. 7, 1904, p. 75 and Jan. 5, 1905, p. 43.

[5] Ibid., Jan. 2, 1908, p. 36. [6] Ibid., Jan. 5, 1905, p. 44.

the initial years of the century. The stock justification by members of the industry for this rigidity was that the price of rails was fair and reasonable, although around the time the price was raised from $28, billets were sometimes selling for more than rails.

In bars, Iron Age reports price agreements through 1905,[1] although the pool with its penalty features closed its books at the end of 1904.[2] In 1907 cooperation was strong enough to enable Eastern bar iron makers to decide to close down entirely for two weeks.[3]

The reports on the formation of the bar association and the plate association should be very interesting to students of the origin of the basing point system because they inform us that in these cases the basing point device was adopted, not in order to save buyers the trouble of looking up the freight charges, but because it was the only method of maintaining uniform prices that was acceptable to all the various interests.[4]

The sheet and tin plate makers, whose price agreements operated at least through 1907, also had an agreement with the manufacturers of rolls whereby the whole output of rolls was to be taken by the members, with no

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[1] Ibid., Jan. 4, 1906, p. 102.

[2] Stanley Committee Hearings, p. 1717.

[3] Iron Age, Dec. 26, 1907, Vol. 80, p. 1836.

[4] Iron Age, Jan. 2, 1902, p. 44. It is stated here that a demoralized market for bars and plates was fortunately avoided "by the manufacturers of each of these specialties formulating plans for maintaining uniform prices, which have proved to be eminently successful. It took a good deal of time to arrive at a basis which would be satisfactory to all the various interests, one great difficulty being in the variety of conditions in regard to location of the mills, proximity to markets, cost of production, etc. The plan finally adopted and which has worked perfectly so far, and is likely to be continued indefinitely, was to base all quotations at a figure agreed upon for f.o.b. deliveries in Pittsburgh. The local mills, therefore, quote Pittsburgh prices--plus freights to whatever point the material has to be shipped."

sales of rolls to independent concerns outside the agreement.[1] At the time this agreement was announced in 1900, it was stated that it was to be a five year agreement, but it is not certain that it remained effective for that period.[2]

Pig iron makers often agreed to restrict output in these early years.[3]

It should not be supposed that prices were necessarily successfully maintained because of the mere fact that price agreements, and in some cases, pools, were in existence during these years. There were usually outsiders who were under no obligation to follow the agreement, and even the parties to the agreements were not unknown to have failed to carry out their undertakings. It could well be argued that agreements were made because prices had not been maintained. Recall the cases of price cutting in this period that were earlier described.

The Gary Dinners

The so-called Gary dinners took place between 1907 and 1911. It is often maintained that by this means U. S. Steel was able to secure the adherence of the other firms in the industry to the desired price schedules. It seems somewhat naive, however, to suppose that Gary's oratory and the speeches made by other members of the industry could be so effective as this. His speeches show little variety and never dealt with a specific situation. He wanted "stable" prices, deplored violent changes, but at the same time wanted "fair and reasonable prices." In view of the difficulties that

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[1] Ibid., Dec. 26, 1907, p. 1836.

[2] Ibid., Dec. 13, 1900, p. 7.

[3] Ibid., Jan. 2, 1902, p. 35; Jan. 5, 1905, p. 69; Jan. 4, 1906, p. 111.

regulatory commissions and the courts have had in applying such standards, it is too much to suppose that they could provide a clear guide to prices for his listeners. When Gary discussed the means by which this happy state of fair and reasonable prices was to be brought about, he said, "Real, hearty, cheerful and continued cooperation on the part of the members will secure results which should be entirely satisfactory."[1] If the dinners themselves had any effect on prices, it probably was through conveyance of the idea that U. S. Steel expected others to follow its prices. On a few occasions, independents might have drawn the inference from the oratory that failure to follow "official" prices would provoke the wrath of the Corporation.

Mr. Topping, active in the industry at that time, apparently did not think so highly of the honor of the members of the industry as Gary did. The following testimony is from the Stanley Committee hearings:[2]

> Mr. Beall. Well, was frequently an appeal made to men's honor /at the dinners/ that they were in honor bound to maintain prices?
>
> Mr. Topping. I do not think that anybody at those meetings felt that they were honor bound to do anything more than to take care of their business as their own judgment suggested it should be cared for.
>
> Mr. Beall. Have you not heard the statement made at the Gary dinners that an obligation to each other was more binding than it would have been if reduced to writing?
>
> Mr. Topping. There may have been something of that kind said by some of the speakers, but it is a good deal like the after-dinner remarks you hear at a great many dinners, when there are a few bouquets passed around the table, and I think beyond that it had no significance.

Out of the dinners, however, came some groups which had more of the earmarks of the usual price agreement organizations. In 1907, a General

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[1] Gary's speech on "Cooperation in the Steel Industry," in which these views are presented, was delivered before the American Iron and Steel Institute on October 14, 1910. It is reported in Iron Age, Oct. 20, 1910, p. 907.

[2] Stanley Committee Hearings, p. 1267.

Committee was appointed at the Gary dinner to promote cooperation in the steel industry. At the same time, a series of subcommittees were named to deal with different branches of the trade.[1] It is in these subcommittees that the opportunity for cooperative action existed, for here specific market situations could be discussed and also the penalties to be visited upon dissidents. No material has been found to give indication of just what these committees did and how well they worked. That these committees had any direct price-fixing power was, of course, disavowed as would be expected.

Apparently the formal disciplinary body of the industry was the Committee on Improvement in Methods. "Methods" is to be interpreted as covering methods of doing business. It was an advisory committee to which any one could apply for advice. Gary suggested that one of the situations in which the committee might be consulted was that in which one believes his neighbor is not conducting his business as it ought to be conducted. (Price cutting?) The committee would then take up the problem with the one whose methods were complained of, and, after obtaining all the facts, advise that individual what ought to be done. There was no obligation to follow the advice, "but frequently, if not generally, the result is that he is disposed to adopt the recommendation of the committee."[2]

After this period, evidence of agreements dwindles, but difficulty with cuts from the basing point price structure remained. In the years preceding the entry of the United States into World War I there apparently was not a great deal of concern over price cuts, but in 1913 all was not well. The comment by Iron Age is restrained but important if accurate, because it indicates

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[1] Iron Age, Dec. 19, 1907, p. 1770.

[2] Ibid., Feb. 9, 1911, p. 348.

that a significant change in price making conditions has taken place.

10-9-1913 IA 798

Iron Age advises that the phrase, "official price," be dropped since prices are no longer made by agreement. The closest approach to uniformity is in steel bars and that is because demand is good. "Yet even in the case of steel bars it is currently known that departures have been made when necessary to secure contracts from the largest consumers."

In the ensuing years, the steel industry had less trouble with price cuts. Then in 1920 an important editorial appeared.

9-30-1920 IA 862

Until the present year, prices have been "very nearly uniform as between the different sellers," and differences in prices for delivery at different points, arising from the Pittsburgh basing point system, have been conspicuous. But in the present year, U. S. Steel has had one set of prices and independents another. The smallest gap between the U. S. Steel price and the lowest price of the independents has been in shapes ($13), although plates may have been $12. [This difference was of the order of twenty per cent.]

1-26-1922 IA 281

For several months prices on bars, shapes, and plates have been quoted in Chicago territory which were not Pittsburgh plus. The actual differential between Chicago and Pittsburgh prices has been about ten cents per pound whereas the freight is thirty-eight cents per pound. Sales by Buffalo and Pennsylvania mills have also been made without definite regard to Pittsburgh basing. Cleveland wire prices do not reflect Pittsburgh plus.

1-5-1922 IA 71

The annual review first made the points given above, noting also that

some mills were using water transportation to meet non-Pittsburgh plus prices. "As a matter of fact, there is never, except when it will best serve their purposes, very rigid observance by the manufacturers outside of Pittsburgh of the Pittsburgh base, but non-adherence is not usually as open as it was during the latter part of 1921."

1-5-1922 IA 2

In the same issue, the cuts by Midvale Steel and Ordnance are described. Actual prices were below official prices a large part of the year and changes in base prices of some products merely recorded what the market had done. The Pittsburgh plus structure was not being observed.

Finally in 1924 Pittsburgh plus was changed to a multiple basing point system. No great change was produced, for this was but formal recognition of what had already in fact taken place as is evident from the citations on the previous pages.

In the twenties the steel price structure seems to have been quite stable, but observance was not perfect as evidenced by the fact that the president of the American Iron and Steel Institute took its members to task in 1928 for charging varying prices to different customers. He feared that the actual, as opposed to the published, price structure might be lowered as a result of this.[1]

Turning now to the 1930's, we find ample evidence of defections from the structure of "official" prices. When Pittsburgh plus formally became a multiple basing point system in 1924, the differential between Pittsburgh and Birmingham remained. This differential was formally eliminated in 1938.

Before the TNEC, Mr. Gregg, of the Tennessee Coal, Iron, and Railroad

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[1] New York Times, October 27, 1928. Cited in A. R. Burns, Decline of Competition, p. 83.

Company testified that they were not receiving this differential from 1933 to 1937.[1] The questioning proceeded:

Mr. Feller. Could you tell us why you weren't getting it?

Mr. Gregg. Yes; because competition wouldn't permit us to get it.

Mr. Feller. Because other producers were selling below the base price?

Mr. Gregg. They were selling at less than our published price; yes.

Mr. Feller. And in order to meet that you came down below.

Mr. Gregg. We had to come down; yes.

Mr. Feller. And was that true in that quarter of 1936 when operations were at a relatively high level?

Mr. Gregg. Yes.

In the same portion of the TNEC hearings, Mr. Fairless (also of U. S. Steel) testified that in the latter half of 1937 his companies were making concessions on the basis of the market that did not appear in published prices.[2]

The fact that actual prices were below published prices for his company in the recession of 1937-38 was confirmed by Mr. Grace of Bethlehem. 1-5-1939 IA 106

In the first quarter of 1938 there was no yielding by the steel companies for lower prices. Considering the small volume of orders, steel prices held fairly well in the second quarter, "but hidden concessions were the subject of gossip, which could not easily be verified." The cuts that had taken place were recognized by Carnegie-Illinois (U. S. Steel) when they announced reductions in June, 1938, of three to four dollars a ton on nearly

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[1] TNEC Hearings, Part 19, p. 10543.

[2] Ibid., p. 10506.

all products. Differentials with Birmingham were eliminated. In October there was a short break in sheets and strip.

In 1938 Bethlehem was again undercutting the official tin plate price. In a letter between officials of American Can it is stated,

> . . . regardless as to the promise made by Mr. Grace at the time the conference was held by leading officials of all the steel companies, regarding the price of tin plate for 1938, Bethlehem again named a price below the official and as Inland was like the others badly in need of tonnage they found it necessary to meet the situation.[1]

Mr. Grace, following standard procedure in situations like this, could not recall any conference such as that mentioned in the quotation.

1-4-1940 IA 92

In 1939, there was price weakness. In May, for ten days, the companies loaded up their order books for sheet and strip at four to eight dollars off published prices. "While price concessions were prevalent on a good many steel products, open breaks in quotations did not occur to the extent that they did in sheets and strip. . . ." Although there were many concessions in the first part of the year, there was no official change in published quotations until the outbreak of widespread price cutting in May.

In this period, another source states that in the spring and summer of 1939, concessions estimated to average six dollars a ton were widely granted. They were taken off on the outbreak of war in Europe.[2]

The foregoing material refers to specific outbursts of price cutting. On a more general level, Mr. Grace stated that his company has secured business by underquoting the published prices on tin plate and other products.[3]

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[1] Ibid., p. 10628.

[2] TNEC Monograph No. 1, Price Behavior and Price Policy, p. 37.

[3] TNEC Hearings, Part 19, pp. 10625-7.

In the earlier years, at least, Bethlehem left the exact prices to be quoted to the judgment of the officials of the sales department. The sales department had absolute authority to meet competition.[1]

Mr. Weir, on being asked by Mr. Leon Henderson what his practice was about cutting below base price during the period when National Steel was being built up, replied, "Well, of course, the theory on which we operated, Mr. Henderson, was that we were meeting competition." The interchange continued:

> Mr. Henderson. Do you mean that the theory you operated on was that you never initiated it [a price cut] but that you met it? Is that it?
>
> Mr. Weir. That was the theory.

But apparently the theory was inappropriate:

> Mr. Henderson. It wasn't the actual practice, though, now was it, Mr. Weir?
>
> Mr. Weir. I certainly wouldn't say so.
>
> Mr. Henderson. Then to that extent you were doing just the thing that calls up the condemnation Senator King has indicated.[2]

Mr. Weir, who also advances the theory that the most grievous sin of the business man is selling at a price that doesn't cover all of his costs, replied that cutting below base price should not be condemned so long as the price permits costs to be covered. The same witness also informs us that in the steel industry the competition at times is so "frightfully keen" that ordinary salesmen are sent out and given authority to take any price that is necessary to get business.[3]

Although Mr. Weir's theories may not command the assent of economists,

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[1] Iron Age, May 24, 1923, p. 1481. Statement of Robert Gillispie, assistant manager of Bethlehem's general sales department.

[2] TNEC Hearings, Part 19, p. 10659. [3] Ibid., p. 10649.

his testimony on pricing practices is competent and deserves their attention.

In the 1930's there is again some evidence of price agreements (leaving aside the NRA period). A letter between officials of the Newport Rolling Mill Company dated August 17, 1935, gives indication of a meeting to agree on prices. It stated, in part,

> It was not definitely decided until late last evening to put into effect for the fourth quarter a one price policy allowing the galvanized sheet price to remain at $3.10 per 100 lbs. for #24 gauge base f.o.b. Pittsburgh. A few of the larger interests such as Weirton and Inland were in favor of reducing the price to $3 base for #24 gauge f.o.b. Pittsburgh but this was finally defeated and it was agreed to allow all prices to remain the same as now in effect.[1]

Another instance of a price conference in later years has already been cited, the evidence coming from a letter between officials of American Can which said,

> . . . regardless as to the promise made by Mr. Grace at the time the conference was held by leading officials of all the steel companies, regarding the price for tin plate for 1938, Bethlehem again named a price below the official and as Inland was like the others badly in need of tonnage they found it necessary to meet the situation.[2]

In order to quote identical delivered prices it is necessary that extras and freight charges be uniform. Extras have been determined in consultation and freight rate books have been furnished by the American Iron and Steel Institute or U. S. Steel has assumed the burden of providing this material.[3] These are necessary if a basing point system is to function according to plan, but they do not of themselves insure adherence to the system.

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[1]TNEC Hearings, Part 27, p. 14506. Mr. Dorenbusch, writer of the letter, stated in response to questioning that there was no conference involving members of companies other than his own (pp. 14281-89). His testimony may be characterized as evasive.

[2]TNEC Hearings, Pary 19, p. 10628.

[3]See, for example, TNEC Monograph No. 42, The Basing Point Problem, pp. 102 and 108; TNEC Hearings, Part 19, pp. 10573 and 10725; and Daugherty, de Chazeau, and Stratton, op. cit., p. 208.

The presence of this type of common action is significant for its indication that there is an attempt to achieve collusion, not that it was successful.

CHAPTER VI

THE LEADER AND OTHERS IN PROSPERITY AND DEPRESSION

Machlup has developed an argument to the effect that a properly operating basing point system will result in a smaller depression fall in sales for the leading firm than for the other firms.[1] This argument, if correct, could form the basis of a test to indicate how closely to plan the basing point system has operated. His argument will be presented first, followed by data for ingots, structural shapes, and wire nails which will permit a test of the theory.

If the firms in the basing point industry were operating in a static situation, it would be in the leader's interest to let the smaller firms dominate their own territories without any cross hauling taking place, for this would permit larger profits. But because of certain dynamic factors, the leader finds it to his advantage to invade the territories of other firms and to permit them to invade its territories. For example, if there is secular growth of demand which takes place to a greater extent in "new" areas than in old areas and if the leader is located mainly in the old areas, the leader will have to invade the territories of the other firms if he is even to maintain his position in the industry. This invasion will also have the effect of discouraging, to some degree, new entrants to the industry, for it will be evident that they will have to compete with the large firm as well as the smaller firms. This is supposed to act as a deterrent because of the possibility that the leader may devote special sales efforts to the small firm's territory. Another dynamic factor that brings about invasion is cyclical

[1] Machlup, op. cit., pp. 154-68.

fluctuation in demand. When demand has declined and the leader has unused capacity, it is to its advantage to extend its sales over a wider area, but the necessity of establishing a clientele leads to an invasion during even times of strong demand. The smaller firms, on the other hand, are supposed to be even less able to compete for business for which much freight has to be absorbed with the result that their sales fall more than those of the leader. The inability of the smaller firm to retaliate rests on the market structure assumption that if counter-invasion by the small firms occurs to the same absolute extent, the small firms will be absorbing freight on a much larger portion of their outputs than will the large firm. Since Machlup argues that the output of the leader does not fall so much as that of the small firms, he must also be maintaining that the small firms do not counter-invade to the same extent. That is, they end up with a larger contribution to fixed costs by suffering the sales reduction in their own territories than if they invaded the leader's market.[1] Why is this the case? If marginal cost of the smaller firm is higher than that of the leader and base prices have been reduced, the net from sales in leader territory may be below the small firm's marginal cost. But if this is not true, it is difficult to see why the output of small firms should fall more (Machlup envisages approximately constant and equal marginal cost) just as a consequence of a fall in demand. On Machlup's assumptions, a fall in demand would seem to affect all outputs proportionately if basing point pricing is observed, although the small firm may show losses sooner than the large firm if the large firm has forced the small firm to reach out for its sales, thus requiring it to absorb freight and thereby obtain a lower net price on its sales than the large firm. With

[1]See especially the arithmetic illustration in Machlup, op. cit., pp. 161-4.

observance of basing point pricing and the assumption of constant marginal cost it does not seem possible to determine the impact of a fall in demand on the leader and the other firms without explicit consideration of how equilibrium among the outputs of the firms is attained. An industry demand curve, a cost assumption, and specification of basing point pricing are not enough for a solution. It is certain that in the steel industry the leader has not permitted the others to sell all they wished at base prices, taking what remained for itself, because outputs of independents have not remained near capacity in the face of a fall in demand, which is what they would do provided marginal cost were approximately constant to outputs near "capacity." The summary categories of selling cost and product variation must be relied on as the means by which sales at each point are divided among the firms.

Now the question is, what happens when demand falls? Offensive action by price reduction is ruled out by the basing point assumption, but sales effort and product variation are still legitimate weapons. If marginal production cost of the leader is below that of the others, it would pay him to spend more on selling effort than if his marginal production cost were the same, but this is of no aid in explaining different relative fluctuations in output over the cycle. Even if his marginal cost is not lower, however, the threat of extensive selling effort may be enough to deter the independent from protecting himself just as, at one time, the threat of a local price war was presumably enough to decide the independent not to use the price weapon.

The cogency of Machlup's argument in application depends on the propriety of the market structure assumption and on observance of basing point pricing, although it seems to lead to a more rapid decline in independents' profits rather than output unless there are introduced factors to induce a change in market shares other than a fall in demand impinging on a certain

cost structure.[1] If this amendment is agreed to, it is still necessary that there be a considerable degree of domination by the large firm and that it be able to increase its sales share, presumably by increased sales effort. This implies observance of basing point pricing to a high degree, for if this were not the case, base prices would be "secretly" cut, making it much more difficult for the leader to invade the territories of the independents or to drive them out of his territory.

Machlup's theory will first be confronted with data on steel ingot production. Deviations from the trend of U. S. Steel's percentage share of ingot production will be compared with deviations from the trend of ingot output for the whole industry.[2]

U. S. Steel's percentage of the industry's output from 1902 to 1948 is shown in Figure 15. A second degree parabola has been fitted to this series. In the lower part of the graph is a jagged curve showing peak and trough years of the general business cycle according to the chronology of the National Bureau of Economic Research.[3] The only purpose of this curve is to show peaks and troughs. The magnitudes of the slopes of this curve are of no significance.

The impressive feature of this series is the persistence with which U. S. Steel's share of the output has declined, although at a diminishing rate.

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[1]Machlup is not entirely clear on this. At one point he seems to say that a fall in demand in itself will cause the leader's share to increase (pp.165-6). At other times he envisages the leader as taking sales away almost at will (pp. 159-60).

[2]Industry output is taken from the Annual Statistical Report of the American Iron and Steel Institute. U. S. Steel's output is taken from its 1948 Annual Report. These data are given in the appendix to this chapter.

[3]See Burns and Mitchell, op. cit., p. 78.

The deviations from the trend line are not large, on the whole. If the deviations from the trend line are compared with the course of the general business cycle, it will be seen that there is no persistent relation up to 1929. If the period from 1930 on is examined separately, then such a regularity does appear, with U. S. Steel's share declining in poor years and rising in good years. This relationship, or lack of relationship, will bear closer examination.

In Figure 16, the absolute deviations from the trend of U. S. Steel's share of the market are plotted against the logarithmic deviations from the trend of the industry's total output.[1] From this scatter diagram, it is evident that in the period 1902-29 there was little systematic relation between these deviations. Omitting 1921, it is even difficult to tell by inspection which way a line of regression would slope. The correlation coefficient is -.24, not a very impressive showing. In the later period from 1930 on, the relationship is much closer with a correlation coefficient of +.72. That is, before 1929, there was a very weak tendency for U. S. Steel's share of the output to increase when industry output declined, whereas in the later period there was a much stronger tendency for U. S. Steel's output to decline when industry output declined.

There is evidently some inconsistency between Machlup's argument (as modified) and the data presented for the period up to 1929. In view of the practically random relationship between fluctuations in industry output and

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[1]That is, a second degree parabola was fitted to the logarithms of total industry output measured in ten millions of net tons. The deviations from this trend are plotted in Figure 16. A positive logarithmic deviation of 0.05 corresponds to a change from trend of about 12%; a positive deviation of 0.10 corresponds to a change of about 26%. A negative deviation of 0.05 corresponds to a change from trend of about 11%; a negative deviation of 0.10 to about 21%.

FIG. 15

U.S. STEEL'S SHARE OF THE INDUSTRY'S OUTPUT OF INGOTS AND CASTINGS, 1902-48

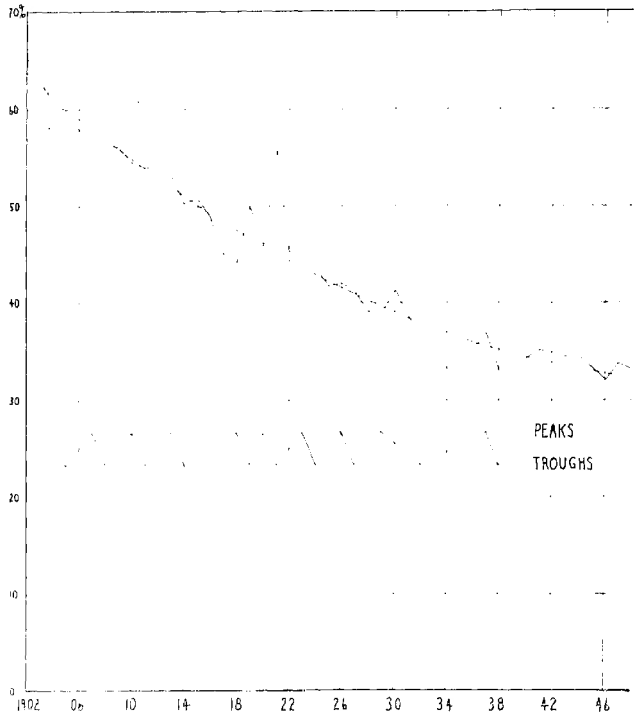
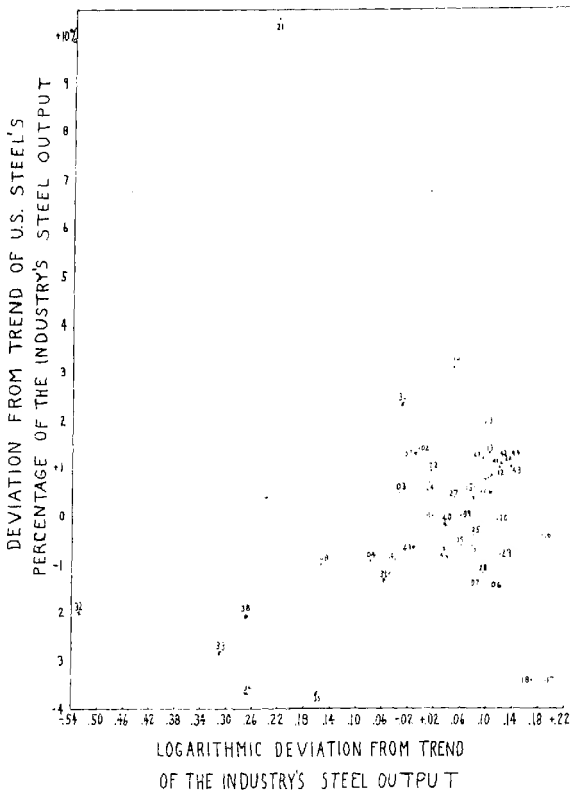


FIG. 16

DEVIATIONS FROM TREND OF U.S. STEEL'S PERCENTAGE OF THE INDUSTRY'S OUTPUT PLOTTED AGAINST LOGARITHMIC DEVIATIONS FROM TREND OF THE INDUSTRY'S OUTPUT, 1902-48



U. S. Steel's share of the market, we may take our choice between concluding that the basing point system was not operating according to plan sufficiently to bring Machlup's mechanism into operation or that this theory does not explain the operation of the basing point system over the cycle. The latter conclusion is the more attractive for two reasons. First, if the data on observance of basing point prices cited in an earlier chapter are at all reliable, the basing point system was working tolerably well. Secondly, the modifications found to be necessary in the Machlup argument left it in a rather strained form with U. S. Steel presumably able to take away business from the independents almost at will. This information might occasion some surprise at the headquarters of U. S. Steel.

The series on ingots, however, may obscure the working of Machlup's mechanism. One reason for this is the fact that part of U. S. Steel's output is sold to other steel companies. Thus, if the other steel companies do in fact lose sales to U. S. Steel when industry output declines, a part of this decline will be reflected in U. S. Steel's ingot output. In addition, Machlup's argument may hold for some products but not for others. In this case, use of the ingot series will obscure the behavior of the separate markets.

For these reasons, it is desirable to supplement the ingot analysis with data for products that move more directly to the "final" purchaser without passing through the hands of another steel company. The first of these products is wire nails. Second degree parabolas were fitted to the absolute values of U. S. Steel's share of the industry output of wire nails and to total industry output of wire nails for the period 1902 to 1929.[1] The

[1]Data are given in the appendix to this chapter.

deviations from the trend of industry output were then expressed as a percentage of trend. These percentage deviations were then correlated with the absolute deviations from the trend of U. S. Steel's share of the nail output. The result is r = +.02, indicating no tendency for U. S. Steel's share of the nail output to increase when total nail output decreases.

The series on nails gives little evidence of a change in behavior over the period studied. In the case of structural shapes, the second "finished" product considered here, two types of behavior seem to be present, however. The method of analysis used for shapes is the same as the one used for nails. The period covered is from 1902 to 1932.[1]

When deviations from the trend in U. S. Steel's share of the shapes output are correlated with the percentage deviations from the trend of the industry's output of shapes for the whole period 1902-32, the result is r = -.10. But if the same variables are correlated for the period 1902-19, the correlation coefficient is r = +.48, indicating that U. S. Steel's share of the output tended to decline when the total output of shapes declined. This is contrary to Machlup's argument.

If the same variables are correlated for the period 1920-32, the sign of the coefficient is reversed, and r = -.58. That is, in these years U. S. Steel's share of the output rose when the total industry output of structural shapes fell below trend.

Although the result for shapes over the period 1920-32 is in accord with the theory under discussion, the theory does not correctly predict the behavior of the earlier period for shapes, nor does it for wire nails. It is possible, of course, that investigation of other products would reveal

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[1]Data are given in the appendix to this chapter.

behavior in accordance with the theory. Should this be true, factors peculiar to those markets should be invoked in explanation. Basing point pricing alone is apparently not enough to bring about the results predicted by Machlup's argument.

What theory is consistent with the data that have been presented? A recent proposal regards basing point pricing as originating principally from geographical fluctuations in demand (with the other necessary conditions of high freight cost relative to final price, a small number of producers at each production center, and a willingness to collude).[1] In this view, basing point price systems are regarded, not as the result of imposition by a dominant firm on an unwilling industry, but as an essentially collusive device to prevent price competition both among firms at a production center and among production centers. In a case in which there is a leader, or dominant firm, I believe this theory creates no presumption either for or against a greater fluctuation in the leader's output than in the outputs of the other firms taken together. It does predict that the leader's output will fluctuate less than the output of a random smaller firm taken individually. Since the course of the business cycle is not uniform in all regions, the cyclical fluctuation in the output of the leader would also be less than that of the individual smaller firm that sells in a smaller number of territories.

This theory does not imply, of course, that the leader's share of the market cannot change over the cycle. It implies only that such change is not a direct consequence of basing point pricing. A successful competitive move by the smaller firms may come during years of low output as well as at any other time, and if it does, the share of the leader will show a decline. It

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[1]George J. Stigler, "A Theory of Delivered Price Systems," American Economic Review, XXXIX (1949), 1143-59.

is suggested that this is the interpretation to be placed on the period following 1929 for steel ingots. This period is not long enough to show an alteration of a permanent nature in the prosperity-depression behavior of the leader's share of output. The decline in U. S. Steel's share of ingot output in the early thirties and in nineteen thirty-eight should be taken to indicate a decline in U. S. Steel's power, as is also true of the long run decline in its share of the market, but it would be rash to conclude that U. S. Steel will hereafter experience a decline in its share of the market when industry output declines.

The data of this chapter can also be used to confront some other interpretations that are sometimes offered for the behavior of the steel industry. A satisfactory interpretation must, at the least, explain the long run decline in U. S. Steel's share of the market and the constancy of its share of the market from prosperity to depression.

The dominant firm interpretation does not meet both of the above requirements. The dominant firm interpretation here means a situation in which the leader, by virtue of its importance in the various markets, is able to determine prices, but is unable to control the amounts that the other firms put on the market. This interpretation can be adapted to account for the long run decline in U. S. Steel's share of the output. But in view of the fairly high cyclical price stability of steel products, it also implies that when demand falls, U. S. Steel's output will fall more than the output of the independents. The data that have been analyzed are not consistent with this implication. It is possible, however, that in the earlier years the change in trend was so strong as to obscure the short run changes. Perhaps further analysis would provide a more important role for the dominant firm theory.

It has been suggested that the theory of the cartel, if not too strictly applied, may be applicable to a number of industries in the United States.[1] In an industry with a leading firm so dominant as U. S. Steel has

[1]Don Patinkin, "Multiple-Plant Firms, Cartels and Imperfect Competition," Quarterly Journal of Economics, LXI (Feb., 1947), esp. pp. 192-205.

been, the leading firm may be regarded as the central office of the cartel. The devices by which the market is divided must be more subtle and indirect than when the cartel can function openly. The cartel idea can explain the price leadership, the rigidity of some of the official prices, and the long run decline in the leader's share of output since in an application to United States industry the cartel cannot be considered to have control over new entrants or the growth of firms already in the industry. Unfortunately for this explanation, however, the time when the challenge to cartel policies should be the greatest is when demand is low or falling. Yet the leader of the cartel suffered no greater a decline of output in these periods than did the other members. A complicating factor here is the length of the construction period for new plants. Their impact will not necessarily be felt when demand is low. Quantitatively, new plant facilities are of less importance than the idle capacity resulting from the declines in demand that have been experienced. But new plants may have a greater importance for price structure than is indicated by their size, for the expanding firms may be more aggressive.

In summarizing the findings of this chapter, it may fairly be said that they are not of a positive nature. However that may be, two theories have been confronted with data they cannot illuminate but should be able to if they are applicable to the steel industry. The data are not so conclusive with respect to the cartel theory. The fourth theory, with geographic fluctuation in demand as a principal element in explaining basing point pricing, receives no positive confirmation from these data, but at the same time is not inconsistent with them.

TABLE 27

PRODUCTION OF STEEL INGOTS AND CASTINGS BY U.S. STEEL AND THE INDUSTRY, 1902-48[a]
(Millions of Net Tons)

	Industry	U.S.S.		Industry	U.S.S.
1948	88.6	29.3	1924	42.5	18.5
47	84.9	28.6	23	50.3	22.8
46	66.6	21.3	22	39.9	18.0
45	79.7	26.5	21	22.2	12.3
44	89.6	30.8	20	47.2	21.6
43	88.8	30.5	19	38.8	19.3
42	86.0	30.0	18	49.8	21.9
41	82.8	29.0	17	50.5	22.7
40	67.0	22.9	16	47.9	23.4
39	52.8	17.6	15	36.0	18.3
38	31.8	10.5	14	26.3	13.2
37	56.6	20.8	13	35.1	18.7
36	53.5	18.9	12	35.0	18.9
35	38.2	12.5	11	26.5	14.3
34	29.2	9.7	10	29.2	15.9
33	26.0	9.0	09	26.8	15.0
32	15.3	5.5	08	15.7	8.8
31	29.1	11.3	07	26.2	14.9
30	45.6	18.8	06	26.2	15.2
29	63.2	24.5	05	22.4	13.4
28	57.7	22.5	04	15.5	9.4
27	50.3	20.7	03	16.3	10.3
26	54.1	22.7	02	16.7	10.9
25	50.8	21.2			

[a]Data are from the Annual Statistical Report of the American Iron and Steel Institute and U. S. Steel's 1948 Annual Report.

TABLE 28

PRODUCTION OF WIRE NAILS BY THE INDUSTRY AND U. S. STEEL'S SHARE OF THE OUTPUT, 1902-29[a]
(Millions of kegs)

	Industry	U.S.S. Percentage Share		Industry	U.S.S. Percentage Share
1929	13.1	39.0%	1914	13.1	46.5%
28	14.2	39.6	13	13.6	44.6
27	14.4	42.0	12	14.7	49.3
26	14.9	45.4	11	13.4	51.4
25	15.5	40.8	10	12.7	55.4
24	15.1	40.2	09	13.9	60.7
23	17.7	45.9	08	10.7	61.2
22	15.0	45.1	07	11.7	66.4
21	11.9	48.1	06	11.5	65.5
20	16.4	54.0	05	10.8	66.1
19	13.1	51.9	04	11.9	67.0
18	12.3	53.3	03	9.6	70.6
17	17.0	54.4	1902	11.0	64.9
16	17.2	54.4			
1915	14.6	47.6			

[a]Data are from the Annual Statistical Report of the American Iron and Steel Institute, various years.

TABLE 29

PRODUCTION OF STRUCTURAL SHAPES BY THE INDUSTRY AND U. S. STEEL'S SHARE OF THE OUTPUT 1902-32[a] (Millions of Gross Tons)

	Industry	U.S.S. Percentage Share		Industry	U.S.S. Percentage Share
1932	.94	43.9%	1915	2.44	46.1%
31	2.06	45.4	14	2.03	47.5
30	3.51	44.6	13	3.00	54.0
29	4.78	41.8	12	2.85	49.8
28	4.10	39.9	11	1.91	47.0
27	3.74	38.8	10	2.27	51.3
26	3.91	39.9	09	2.28	47.1
25	3.60	40.7	08	1.08	47.1
24	3.28	42.8	07	1.94	54.9
23	3.41	48.0	06	2.12	54.6
22	2.72	46.3	05	1.66	54.6
21	1.27	47.5	04	.95	55.1
20	3.31	43.9	03	1.10	60.3
19	2.61	43.8	1902	1.30	57.9
18	2.85	48.4			
17	3.11	47.9			
1916	3.03	49.4			

[a]Data are from the Annual Statistical Report of the American Iron and Steel Institute, various years.

CHAPTER VII

SUMMARY

In view of the variety of topics that this study has dealt with, it should be helpful to provide a brief summary of the argument and the findings. At the outset some of the concepts of concentration that have been used by various writers were examined and their limitations noted. The idea of domination, present in all of them, was found to be closely allied with the concept of inequality. A measure of concentration was then proposed which reflects both domination (or inequality) and the number of firms in the industry.

On applying this measure of concentration to pig iron capacity, it was found that the index rose from .03 in 1898 to about .20 after the formation of U. S. Steel in 1901. It has since remained at this level with no continued tendency to move in either direction. The concentration index for steel ingots behaved differently. With the formation of U. S. Steel it rose from less than .10 in 1898 to .31 in 1904. Then began a persistent decline, lasting until the early 1920's. From that time on, the index has remained quite stable at a level of about .15. It was also found that the regional structure of production for three products had, on the whole, noticeably improved over the period from 1904 to 1938, both within regions and between regions.

Turning to other evidence on the development of monopoly, it was found that the flexibility of basing point prices showed no tendency to change over the period studied. This was clear when flexibility was measured by the coefficient of variation. The conclusion was not so clearly indicated when flexibility was measured by relative frequency of price change. But since

the flexibility of "official" prices was investigated as a step toward a finding on the flexibility of actual prices, flexibility of base prices as measured by the coefficient of variation is the significant measure. The second step in the argument was to investigate the degree of adherence to base prices over the cycle. Although the data are sketchy, it appears that an increase in the flexibility of observance took place at some time after the early twenties. From the data on observance it cannot be discovered whether this development began at some time in the twenties or the early thirties. Subsequent analysis, which showed that the cyclical relationship between U. S. Steel's share of the industry output of ingots and industry output changed around 1929-30, perhaps suggests that flexibility of observance may have begun its increase in those years, although it was not concluded that the change in the behavior of U. S. Steel's output share was permanent.

Lack of change in flexibility of basing point prices together with an increase in the flexibility of observance of these prices imply an increase in the flexibility of actual prices. Making use of the hypothesis that price rigidity and monopoly power are directly related, a smaller degree of monopoly power in the later years is indicated.

Non-quantitative evidence on agreements was examined. The publicly available evidence has dwindled over the years, which may indicate a decline in the use of agreements. In the analysis of identical bids on government contracts the data covered a period but little longer than one year. The nature of the cooperative policy present in a basing point system was explained, however, and it was shown that collusive bidding, in so far as it is revealed by identical bids, was present in but a minor portion of the bid openings for iron and steel products. The general picture of a substantial decline in the power of U. S. Steel and a movement to a higher level of

competition was not upset by the examination of value added which extended back to only 1919. The study of rates of return on sales for the three largest steel companies provided some additional confirmation of the correctness of this view. There was a particularly close correspondence between the decline of this ratio for U. S. Steel in its early years and the decline in concentration in steel ingot capacity.

Taken together, all of this constitutes a fair body of evidence in support of the proposition that the steel industry has become more competitive over this period. The data are sketchy and the important problem of ore control has not been examined. Hence the above conclusion strictly applies only to that portion of the industry from blast furnace on and should not be interpreted to mean that conditions of entry have undergone any significant change. The changes that have taken place in this industry have not been revolutionary and perhaps a good deal of progress could still be made toward more competitive results, but the direction that developments have taken seems clear.

A study limited to one industry does not permit a general answer to the question of whether there is a persistent and widespread trend toward concentration or giantism, but this study should provide a useful challenge to those who think the steel industry has become more monopolistic over the years. It may be that this opinion is not widely held among economists, but even if this is true, it obviously has not prevented wide acceptance of this opinion in other quarters. The important lesson from this study is that even though firms grow in size, the significance of that growth can be diminished or entirely overcome by the simultaneous growth of the industry and of the market open to each of the firms. This lesson, even though clear on an *a priori* basis, seems to be all too easily forgotten in making judgments on

the trend of concentration. It is also possible that we tend to underestimate the difficulties in setting up and maintaining a monopoly position. In the steel industry the competitive structure and performance changed for the better even in the face of the basing point system, a good mechanism for the prevention of price competition, and some rather difficult circumstances to be overcome by the prospective entrant to the industry.

What is the connection between a knowledge of the trend of giantism and our choice of policy? It is hard to see why this trend should have any influence on the direction of policy, for it cannot be maintained that the direction of current developments should be the source of the ends of policy. But the trend and also the level of giantism will properly influence the rate at which we think policy should move us toward its goals. Rather general agreement on policy is necessary, both for its adoption and effective execution, and it is probably true that agreement is harder to secure the more rapid is the change proposed. The danger is that an erroneously high estimate of the rate at which we are moving to giantism may lead to the conclusion that it is politically infeasible to stop it, with the result that we turn to less satisfactory methods of handling the problem of bigness.

In the investigation of the monopoly problem, how useful is a concentration coefficient? In this study there has been little disagreement between the indications of the concentration coefficient and the other evidence that has been examined. This agreement may be only apparent, because the changes in monopoly power have not been great enough or frequent enough to provide a good test, and the data used have been scattered in time. On a priori grounds, a concentration coefficient probably cannot be trusted to move closely with the degree of monopoly. There are factors at work other than those taken account of in a coefficient of concentration and they need not be perfectly

correlated with the measure of concentration. Some of these other factors may move in a direction opposite to that of concentration. Three factors that come to mind are product competition, changes in the scope of the market not taken into account in the measure of concentration, and changes in the "psychology" of the members of the industry, or their willingness to collude. Provided the legal and patent setting in which the firms are operating does not change, a good case can be made for the view that a concentration coefficient will usually indicate the correct direction of a change in monopoly power. This is subject to the qualification that when concentration is low, changes in it will probably produce no change at all in the performance of the industry. Also, in view of the probable long term changes in product competition and size of markets, an increase in concentration is more likely to give the wrong indication for change in monopoly power than a decrease. A coefficient of concentration may serve tolerably well to indicate changes in the direction of monopoly power, but it is defective as an indicator of the level of monopoly power. A low level of concentration would probably correctly show a quite competitive situation, but concentration would have to be quite high before it would definitely indicate a non-competitive performance.

If measures of concentration are subject to these important limitations, it may be wondered why attention should be devoted to them. First of all, we are interested in trends, even if only of direction, because they can direct attention to potential trouble spots. Secondly, whether measures of concentration play an important part in anti-trust policy depends on the fundamental objectives of policy. If the main objective is only to detect and correct situations in which performance is monopolistic, then it would be quite correct to place little reliance on measures of concentration and similar simple

measures of structure in view of their deficiencies. If this is the objective of policy, reliance on either measures of structure or performance produces errors. If only measures of structure are used to detect monopoly, then action will be taken against some firms that do not meet tests of structure but which would, in fact, meet tests of performance. If reliance is placed on tests of performance, some monopolistic firms will go unscathed because of our weaknesses in assessing performance.

If it is proposed that tests of both structure and performance be used, it may fairly be objected that this will actually turn out to be a use of performance standards only. The main reason for suggesting the use of both probably lies in the fear that the test of structure will often give the wrong answers. The result is that structural considerations will be used only as a rationalization of decisions already made on grounds of performance.

It cannot yet be concluded, however, that structural considerations, of which measures of concentration are one example, should have but a minor role in our anti-trust policy. There are two cases in which the test of structure would play a major role.

First, even if our objective is only to eliminate monopoly, reliance chiefly on the test of structure might be justified simply by a comparison of benefits with costs. Perhaps the benefits from a more complete elimination of monopoly do outweigh the costs society would incur through the harassment of some industries those performance is actually quite competitive but whose structure, by the conventional standards, is not.

The second situation in which the test of structure would play the main part involves specification of the fundamental objectives of anti-trust policy. If these objectives are wider than the attainment of proper performance, then great emphasis on structure could be quite proper. In the minds

of some, anti-trust policy should have as its objectives the provision of wider opportunity, better conditions for the development of leaders, and the like, as well as the attainment of "competitive" performance. A collateral advantage might lie in the greater ease of getting political support for measures that would disperse political and economic power residing outside business firms. It is not the purpose here to argue for a certain set of objectives. But in our haste to point out the limitations of structural measures as indicators of performance, we should be careful not to neglect discussion of the fundamental objectives of anti-trust law. Perhaps they should include more than the elimination of monopoly.